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ROTARY TRANSFORMERS.

There is no branch of electricity which is to most engineers more fascinating and at the same time offers greater problems for solution than that of the transmission and utilization of electrical energy at comparatively long distances. In his inaugural address, recently delivered before the American Institute of Electrical Engineers, President Duncan discussed the several methods which are either in practical use or are perfectly feasible, but owing to the scope of the subject which he treated it was not possible to go into details, regarding in each case the many points of merit possessed by the various systems. The valuable services which the rotary transformer is capable of rendering have not been generally recognized and it is for this reason that its use should be carefully considered. The rotary transformer was originally designed to transform alternating currents to direct currents, and for this purpose it has received during the past three or four years an extensive application. Another important point already made use of, but not generally known, is that which Mr. Steinmetz pointed out in the discussion which followed the presentation of President Duncan's paper, namely, that the rotary transformer possesses all the essential features of a booster, inasmuch as it offers a means of compounding or over-compounding, so that any desired voltage, within proper limits, may be maintained at its dynamo terminals, irrespective of the load and generator voltage. This is accomplished by varying the field excitation of the rotary transformers, thereby varying the phase relation between the voltage and current. As explained by Mr. Steinmetz, the transformer is under-excited at no load, causing a large lagging current, and the E. M. F. of self-induction being opposed to the voltage of the generator, the latter is lowered as may be desired. The excitation is increased as the load increases, so that finally a point is reached when the E. M. F. and current are in phase. With still higher excitation, the E. M. F. of the rotary transformer becomes greater than the impressed E. M. F. of the generator and the current is made to lead, with the result that the E. M. F. of self-induction becomes to some extent in phase with that of the generator, thereby causing the voltage at the rotary transformer terminals to become the greater, the line voltage increasing with increasing distance from the generator. This is accomplished by allowing the series winding to largely predominate over the shunt winding in the excitation of the rotary transformer, a method of regulation which has, according to authoritative statements, been in successful operation on an electric railway system for about two years, and is one which doubtless could be applied to the lighting field as well. It at least offers one satisfactory solution of the many perplexing problems of electrical supply now confronting the engineer.

BALANCING ARMATURE REACTION.

On another page we print an article by Mr. F. H. Sleeper, entitled "Distortion of Field by the Armature," which, while it does not announce a new principle, presents a very clear statement of a method of balancing armature reaction, and for this reason is commended to those who are not conversant with this important and interesting subject. A prominent manufacturing concern produces a machine in the construction of which the same principle is utilized, but to a much greater extent than that suggested by Mr. Sleeper, and it is a question whether the simpler method is not preferable. Machines are now built without any compensating

devices whatever, that require but little shifting of the brushes to ensure sparkless running. By means of a series coil and carefully shaped pole-pieces sparking is so thoroughly eliminated that many manufacturers claim for their machines absolute immunity from these evils, and in a few cases their claims have some foundation. It would seem that a very few turns wound on a portion of the pole-piece, as suggested by Mr. Sleeper, would obviate the difficulties aimed at. These turns, of course, must be series turns, for the conversely distorted field must increase to the same extent as the armature field, in other words, in direct proportion to the load. A discussion as to a method of determining the number of these auxiliary turns by calculation would be of interest, but it is probable that the results of such calculation could only be used as an approximate guide. A margin should be allowed, and the exact magnetization should be produced by shunting, for the reason that it would be impossible to predetermine the reactive effect of the armature with sufficient accuracy to wind the coils in exact accordance with the calculation. In the last issue of The Electrical World a dynamo using a somewhat similar device was suggested by Mr. Alexander Rothert, but for a different purpose, namely, the production of a three-wire dynamo. The pole-pieces were sub-divided and magnetized to different degrees of intensity to produce the desired results. With a slight modification Mr. Sleeper's dynamo could feed a three-wire system without difficulty.

INSULATED WIRES AND CABLES.

The manufacture of insulated wires and cables for electrical purposes is a subject that is comparatively little understood, mainly for the reason that few are engaged in this particular branch of industry, and even among these there is often a disposition to surround the business with an air of mystery and secrecy. Such a practice is, of course, a matter of business policy, and we find similar notions prevailing in many other lines of trade. In some instances there are real secrets to guard, but in a majority of cases the supposed secrets are such only in appearance and by inference. The article of Mr. J. Draper Bishop, on the construction and design of insulated wires and cables, which is printed on another page, gives an account of the processes employed in their manufacture and is one of the most practical and interesting papers that has come into our hands of late. Mr. Bishop describes the manufacture of cables in considerable detail, excepting deep-sea cables, the production of which is controlled by a few foreign corporations, who keep their process a secret. The class of cables in which we are more directly interested, however, forms the subject of the article, and the processes employed in their manufacture are described in exceedingly clear and comprehensive language. The properties of that most essential substance used in the manufacture of cables, namely, india rubber, or caoutchouc, are fully described, but Mr. Bishop in that connection makes a statement that is at variance with what we have been taught to believe are the real facts in the case. He asserts that the supply of rubber is practically inexhaustible. In recent years attention has been directed to the threatened depletion of the rubber supply by reason of the wanton destruction of the rubber trees by the natives of the regions in which the trees flourish. The best sources of supply, it is said, cannot be depended upon many years more, and so threatening has the danger of exhaustion become that attempts have been made in some countries to take better care of the trees. In some cases rubber trees have been transplanted in foreign countries where the climate is suitable, in order to provide additional sources of future supply. In our own country the matter has been agitated, and steps are now being taken to introduce the rubber tree in Southern Florida, where, it is supposed, the climate and soil will favor its growth. The supply of the best rubber, which is none too good for first-class insulation, we fear is not so plentiful as Mr. Bishop's estimate would seem to indicate.

THE TELEPHONE AND THE TELEGRAPH.

On election night the telephone companies in this city and other cities throughout the country served their subscribers with election returns, thus entering a field that has hitherto been monopolized by the telegraph companies. This special telephone service was rendered in a manner similar to that practiced by telegraph companies in the distribution of such news and, as far as we can learn, was entirely satisfactory. At this particular time this new departure in the telephone business is looked upon by many as possessing much significance. The famous agreement between the Bell Telephone Company and the Western Union Telegraph Company has expired, or is about to expire, and according to reports there is no probability of its renewal. The question then naturally arises, "What will be the relations between the two concerns when the compact ceases to be effective?" Many rumors have been current lately regarding the situation; some to the effect that open hostilities would follow the expiration of the agreement; some that a new agreement would probably be effected, while others took the middle ground and alleged that there would be no warfare and no new agreement—that each company would attend to its own affairs and not meddle with those of the other. Just what action will be taken after the agreement has expired it is impossible to learn, but whatever turn events may take it is evident that the telephone companies with their present plants just as they stand to-day can become formidable competitors of the telegraph companies, while the converse cannot be said to be equally true. The dissemination of election returns by telephone is an encroachment on a field heretofore wholly monopolized by the telegraph, and if the telephone has made a mark in this one direction it does not require a very great stretch of imagination to see that it may successfully compete with its older rival in other and regular channels. The one prominent fact developed in this connection is that the telephone companies need not go into the telegraph business at all; a lowering of local and long-distance rates would be a very effective means of securing a large share of the business which is now transmitted by telegraph. The telephone therefore seems to be in a better position to take the offensive than the telegraph, and the course of events will be watched henceforth with deep interest.

THE BUSINESS OUTLOOK.

The unanimity of opinion as expressed in the views of many of the most prominent individuals in the electrical and kindred trades, respecting the business outlook as a result of the recent election, which opinions are published elsewhere in this issue, is indeed remarkable. Never before have we heard of such concordance of sentiment in any line of trade regarding any one particular condition or fact, and that such a feeling exists in the electrical business at the present time augurs well for the future. The existence of unfavorable conditions have been only too apparent in the general industries of the country for the past few months and business was during that time at a standstill, pending the settlement of the issue involved in the Presidential campaign. The result of the election has had the effect of inspiring all classes of business men with a hope that is rarely equaled in industrial circles, and the confidence that now prevails cannot fail to stimulate business activity.

The Berliner Suit.

The suit of the United States *vs.* the American Bell Telephone Company, involving the Berliner patent, came up for argument on Monday, Nov. 9, before the United States Supreme Court. The counsel for the telephone company were Messrs. J. J. Storrow J. H. Choate and W. W. Swann, and that for the United States Judge Taylor and Mr. Causten Browne. Mr. Berliner was present as an interested spectator. The case was called at 3 p. m.

Standard Cells.

BY HENRY S. CARHART.

Standards of E. M. F. have lost none of their interest to electricians. In fact, since the legalization of the Clark cell, they are of more importance than before. Two interesting papers on standard cells have recently appeared, one by Prof. Ayrton and Mr. Cooper on the "Variations in the E. M. F. of Clark Cells with Temperature,"[1] and the other by Mr. W. Hibbert, in the London *Electrician*, July 3, on "A One-Volt Standard Cell."

The former paper is an elaborate account of an investigation of the lag of E. M. F. behind the temperature changes of the Clark cell. This lag is appreciable for comparatively slow changes of temperature. The effect is an apparent diminution of the temperature coefficient. If a cell is placed in a water bath which differs by as much as 3 degrees C. from the previous temperature of the cell, the lag after half an hour may amount to as much as 0.1 per cent. Generally it will be less than this. This is equivalent to an error of 1 degree in reading the temperature.

The authors of the paper say that "it has for some time past been suspected that the lag of the E. M. F. of a Clark cell behind the temperature was due, not merely to the mean temperature of the cell itself lagging behind that of the bath, but to time being necessary for the variations of the amount of crystals in solution and for diffusion to take place." To say that this effect has been "suspected" is ignoring much that has been written on the subject. This phenomenon I described in my "Primary Batteries" in 1891, and explained that the temperature coefficient of a normal Clark cell is made up of two parts, one of which is "a secondary change resulting from a variability in the density of the zinc sulphate solution." The effect on the responsiveness of the cell to temperature changes is also described. This slowness of the Clark cell in attaining an equilibrium of E. M. F. after a change of temperature was described also in my paper on "A One-Volt Cell," in the *American Journal of Science*, July, 1893. Attention was called to the same phenomenon in Section A of the B. A. meeting at Edinburgh in 1892 by Mr. Glazebrook and myself. No one who has made some thousands of comparisons of Clark and other standard cells could fail to note the lag described. But it is almost wholly eliminated in cells containing no crystals to dissolve on heating.

Mr. Hibbert makes no mention in his paper of any previous work on a one-volt cell; and Mr. Fisher, who investigated Hibbert's cells, says[2] if these cells are successful in passing "time tests they will certainly supply a want as the missing full volt standard." This full volt standard has not been missing since the publication of my paper on the subject in 1893. They have been used as practical standards by the Weston Electrical Instrument Company, which supplies the standard voltmeters for the entire country. Under date of Sept. 19, 1895, Mr. R. O. Heinrich wrote me that one of these cells, which had unfortunately leaked through its seal, "was like the apple of my eye, and many silent hours of the night were spent on its study. . . . The beauty about the cell was that its E. M. F. was probably 0.02 per cent. of one volt at 20 degrees C." Again, he says: "I have quite as much confidence in their constancy as I would have in a Clark cell, not mentioning the comfort of the small temperature coefficient." The "missing link" was therefore supplied before our friend in England took the matter in hand.

The principal object in writing this article is to give some account of a few standard cells which I have kept for several years. My old No. 1 Clark, contained in a 5-inch test tube, was set up in June, 1887. That it has suffered no impairment by reason of frequent service and advanced age is evident from the following comparison made Oct. 26:

No. of cell.	Set up.	Temp., C. Degrees.	Res. to balance.
1	June, 1887,	17.4	9301
31	Sept.. 1892,	17.4	9301
35	April, 1895,	17.4	9301.3
30	Sept., 1892,	16.45	9310.4

A reduction of the last to the temperature of the others gives 9303.4. These numbers are the resistances out of 10,000 ohms required to balance in the potentiometer or Rayleigh method of comparison. No. 1 has been tested from year to year by comparison with other standards and by the silver voltmeter method. Its voltage is fully up to the legal standard still. It has been compared with a standard made after the legal specification contained in the law of Congress passed in 1894, and the agreement was found to be almost exact. This legal standard has since cracked at the negative terminal. This difficulty, which was found by Lord Rayleigh, can be gotten over by sealing in the platinum wire with lead glass. In a recent letter from Dr. Kahle, in Berlin, he says that he has about 30 of these cells five years old, and none of them show any break at the negative pole.

Occasionally a Clark cell exhibits a variation from the mean of others; hence we should not put all our eggs in one basket by trusting to a single cell. Good agreement with two or three in a sufficient ground for confidence in the mean.

Turning now to the calomel cell, I have the first four cells which I made for the purpose of determining the density of the solution required to give one volt. Numbers 1 and 2 were never very near one volt, but numbers 3 and 4 were much nearer. Regarding their constancy, I append relative values compared with normal Clark cells four years ago and at present:

No of cell.	Set up.	Tem., C. Degrees.	E. M. F. 1892	E. M. F. 1896.	Temp, C. Degrees.
1	Oct., 1892.	15	0.9975	0.9975	14.6
2	Oct., 1892.	15	1.0328	1.0323	14.6
3	Oct., 1892.	20	1.0002	1.0001	20
4	Nov., 1892.	14.7	1.0003	1 0003	14.4

No. 5 was sent to Mr. Heinrich in May, 1894, and it has since remained in his possession. In May, 1893, it had an E. M. F. of 1.001 at 20 degrees C., compared with No. 30 Clark. It had the same value the following November, though in the mean time I had carried it in my pocket to Chicago and back. March 8, 1895, Mr. Heinrich compared it with the one above referred to and found its E. M. F. to be 1.0012 volts; from the silver voltameter test he found precisely the same value, both at 20 degrees. March 25, by comparison, it was again 1.0012, and by the silver voltameter 1.6010, both at 20 degrees. I have the data of a number of comparisons made on this cell, giving an E. M. F. ranging from 1.0005 to 1.0011 at 20 degrees C. To reduce all the comparisons to the same temperature a coefficient of 1,001 per cent. was used.

The only difficulty of importance encountered in making one-volt calomel cells is to secure sufficiently pure zinc chloride, free from the oxychloride, and to adjust the concentration to give one volt. The percentage variation of the E. M. F., with a given variation of the concentration, is greater with zinc chloride than with zinc sulphate. These difficulties are not insuperable, and with the methods now employed I have great faith in the permanency of the calomel cell. Their convenience is beyond question, both because the E. M. F. is one volt and because their temperature coefficient is almost negligible—about one eighth that of the normal Clark cell.

[1] Proceedings Royal Society, Vol. 59.

[2] *Electrician*, March 13, 1896.

Standard Screw Gauges.

At the meeting of the British Association at Ipswich in 1895 a committee was appointed to consider the subject of standardizing screw gauges and place the matter on a thoroughly practical footing. At the recent Liverpool meeting of the association this committee made a report which, it is stated by our London correspondent, will result in a practical provision for the permanent establishment of the standard screw gauge. It is proposed to provide a central depot where primary standards are to be preserved. At this depot master gauges belonging to manufacturers will be checked against primary standards, and it is proposed to have either a microscopic or photographic method of checking. In the photographic method a print is obtained forming a comparison picture of the primary standard, the gauge to be checked and a scale to one ten thousandth of an inch. At factories means are also to be provided for workmen to check their taps, dies and screw-plates. Accurately standardizing half-nut gauges will be sent to factories requiring them and by means of these the pitch of threads can be checked from time to time to test whether they have been injured by use. Standardized gauge-calipers will also be sent out from the central depot to enable workmen to test the inside and outside diameters of the screws. The report also contains a table giving the size of the gauges together with a "working margin" between full and open threads.

Electric Light Preferred to the Welsbach.

Some statistics of electric lighting in Paris published in a French contemporary, point out the interesting fact that during the past year a number of the patrons of electric lighting stations abandoned the light in favor of the Welsbach incandescent gas light, but after giving these a fair trial they again adopted the electric light, even though the price was higher.

The Fire Risk in Belt Transmission of Power.

BY WILLIAM ELMER, JR.

In conversation with a well-known mechanical engineer recently, the topic finally reached was the problem of the modern systems of transmission of power. Various phases of the matter were discussed, and at last the question of fire risks was brought up. The relative safeties and dangers of the belt and line-shaft methods were contrasted with the systems using electric motors, and the writer, who is an advocate of electric power in small units, undertook to hold up that end of the debate. The well-known dangers of hot journals were pointed out and the opposing side adduced the heating of wires from overloads on the failure of fuses to blow. This overheating of wires is a matter of which we have heard a great deal in times past, and of which we hear considerable at the present time, but it seems that the condition of affairs must have been exaggerated. Every fire in a manufacturing establishment which is not proven to be due to some definite cause is, for want of a better scapegoat, assigned to a defect in the electric wires. Truth compels the statement that in a great many electrical installations, particularly those made some time ago, the wiring is in very bad shape. Wooden cleats can be found in abundance, wires run under and in contact with pipes, lamp-cord hooked up on nails and circuits overloaded by the continual addition of lamps. These things are bad enough, and should be remedied at once, for no one can tell when the time may come for the catastrophe to occur. It has often occurred to me that the underwriters would have their hands full for about a year if they did nothing else but go around the country condemning the old wiring which is such a menace to the owners of the various establishments where it is to be found.

But granted that all these things are so, the question is do the fires started by electrical troubles cause more damage than those started by hot boxes? Statistics will prove that they do not. A single instance of a fire in a belt system of transmission of power will serve to illustrate the point. In a certain mill, which shall be nameless here, one room was cut off entirely from the main floor by a solid brick wall. This wall was pierced by but two openings, these being merely horizontal slots wide enough to allow a belt to pass through. The main line of shafting drove the isolated machines in this small room by means of a belt which came through these slots in the wall. A short countershaft received the power and distributed it as needed. The mill happened one week to be working overtime in certain departments, so that this left the main floor unoccupied. The engine which supplied the whole establishment with power had to be run and drive all the line shafts in the building. This gave the few attendants an unusual amount of work, and for some reason the countershaft in that certain little detached room was neglected. It does not appear that the thought ever occurred to the oilers that the isolated situation of the room immunized the mill from the risk of a fire starting there, but it would certainly seem that if a fire had to start that was a pretty safe place to have it begin. A solid brick wall is considered a very good fire insulator, and the presence of those two small slots would hardly be taken into consideration.

But let us see what really did happen. After an indefinite number of thousand revolutions, a box on that countershaft became dry. After some more revolutions it ran hot and finally blazed up. The shafting and hangers in the mill were caked with dirt and oil, and the next thing that happened was that the lint and dust on the belt caught fire. The fire traveled with the revolving belt through the openings in the wall and ignited the grease on the hanger nearest the driving pulley on the main line-shaft. Then the oil and dirt on the shaft carried the flame along from one hanger to the next until, in less time than it takes to tell it, the whole floor was ablaze from end to end. The mill was doomed and burned to the ground. "For the want of a nail, etc."

This is but a single instance, but it might be multiplied indefinitely. There are plenty of cases of blazing boxes and journals every day. Who has not seen half a dozen a year on the various railway trips he has taken? And if a car journal can run hot, why not a line shaft-box? The truth is, it is only by the most constant vigilance that this danger is averted, and any neglect on the part of the man with the oil-can is liable to be paid for dearly.

Vertical belts are also a source of great danger, as the openings they necessitate from floor to floor form great chutes for the transmission of fire from cellar to roof. A fire once started in the basement roars up one of these sets of openings as up a chimney and nothing can stop it. The evident remedy is to have no vertical belts. Drive each section of shaft by its own motor. Better still, drive each machine by its own motor. Then if any one floor, or part of a floor is wanted, everything else can stand perfectly still. In working overtime any part of the shops can run in entire independence of any other part, and there would be no necessity for constant attention to the boxes of revolving shafts all over a big building. Properly wire a structure in the first place, and provide each motor circuit with an efficient circuit-breaker, and there will be no more danger from the electric wires than from the girders themselves.

New Plans for Rapid Transit.

Engineer William Parsons has submitted to the Rapid Transit Railroad Commissioners new plans for an underground rapid transit system based upon the resolution adopted by the Commissioners in August last.

Mr. Parsons' plans provide for a line from the Post Office to run to New Elm Street, Lafayette Place and Fourth Avenue to the Grand Central station, with four tracks. At the latter point the tracks will divide into an east and west side route, each with two tracks. A third track is provided for where necessary for express service. The west-side route as proposed will pass under Forty-second Street to Broadway and up the Boulevard to about 125th Street. The east-side route will pass along Park Avenue for a short distance and thence through private property to and beyond the Harlem River. It is estimated that the cost of construction of the system will not be more than $30,000,000.

Mr. Parsons provides for pipe galleries on each side of the track in Elm Street, and a third track on the west side route from Fifty-eighth Street to Ninety-eighth Street. This line he would carry over the Manhattanville Valley on a viaduct extending to 135th Street. The western route he regards as comparatively easy of construction. The eastern route, however, presents a more difficult problem. There is only room for two tracks on each side of the Harlem railway tunnel. He suggests the route up Fourth Avenue on the west side of the tunnel to 110th Street with a diverge to the west through either 110th Street to Lenox Avenue and up Lenox Avenue to the Harlem River, or through back lots of private property abutting 110th Street to the east of Lenox Avenue, thence to the Harlem River, avoiding Mt. Morris Park by constructing a curve. This line, he suggests, might be carried to 150th Street in the annexed district.

Mr. Parsons provides for a loop around the Post Office, and a two-track line down Broadway to South Ferry.

The length of the lines according to this latest plan would be about as follows: 10.9 miles of two-track road, 3.99 miles of three-track road and 3.03 miles of four-track road. The cost of construction based upon old estimates and some new data is placed at $20,048,000. To this is added $3,000,000 for private property to be taken, $1,200,000 for interest, and 20 per. cent. for contingencies, making a total of $29,097,600. In this estimate no allowance is made for damages to abutting property. The route through the blocks on the east side north of 110th Street could be built on a viaduct of brick arches and the side streets could be crossed on steel arches reaching from house line to house line. Above the Harlem River it is proposed to carry the road on an elevated structure.

The Standard Telephone & Electric Company and the Watson Telephone Switch Patent.

The Electrical World is in receipt of a telegram from the Standard Telephone & Electric Company, dated Madison, Wis., Nov. 9, showing that to the efforts of the Standard Company in behalf of its patrons the first acknowledgment is made by Messrs. Barton & Brown, the Western Electric (American Bell) Company's attorneys; that the celebrated Watson telephone-switch patent, No. 270,522, is null and void in the United States, in confirmation of which the Standard Company telegraphed the following copy of communication received by its attorneys:

Messrs. Morris & Morris, Madison, Wis.:

Referring to the suit of the Western Electric Company *vs.* the Standard Telephone & Electric Company on Patent 270,522, and the plea setting up Canadian patent for the same invention of July 30, 1880, we have to say that your plea was the first notice or information of any kind leading us to even suspect that there was a foreign patent which limited the term of the United States patent. It was only yesterday that we saw a copy of the Canadian patent It is, of course, a bar to the suit, and we shall acccordingly direct that the suit be dismissed at complainants' cost. Very truly yours,

BARTON & BROWN.

The Electric Light and the Telephone in Announcing Election Returns.

The returns of the late Presidential election were presented to the interested New Yorkers almost entirely by the use of electrical methods in some form or other, aside from the telegraph and telephone. New York City was a veritable panorama of flashes, fireworks and stereopticon pictures, all of which had a meaning and could be read as plainly as print. Almost all of the newspapers had an elaborate system whereby the result could be immediately announced to hundreds of thousands of people. The electric stereopticon was, of course, the most prominent feature in making these announcements and it was utilized in Printing House Square to an extent that perhaps has never been equaled in the history of the country. The New York *World* building was covered with an enormous screen which was no less than 150 feet long and 40 feet wide, and upon this were directed six stereopticons illuminated by electric lights which received their currents from two wires running over to and through the *World* building and down to the private dynamo room. The electrically lighted dome of the building was utilized as a signaling device to announce the more important features of the result. This was accomplished by the display of different colored circles of light,

FIG. 1.—VIEW OF PRINTING HOUSE SQUARE.

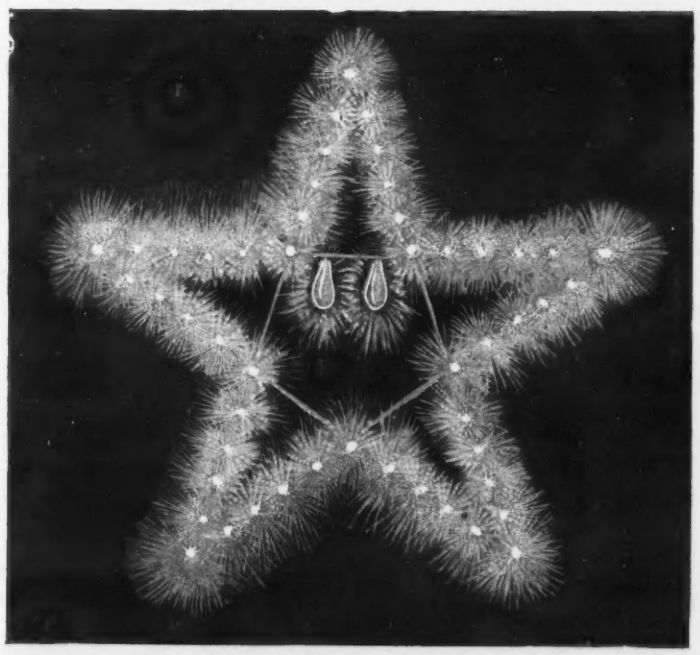


FIG. 2.—ARRANGEMENTS OF LIGHTS ON THE STAR.

and the Republican victory was made known to the people by the flash of golden light covering the entire dome.

The *Sun*, the *Journal*, the *Tribune* and the *Times* all utilized electric stereopticons, the beams of which were thrown from platforms built up in the square onto the screens hung from the buildings of the respective papers. Printing House Square presented quite a collection of curious structures, and its general appearance is represented in one of the illustrations.

On the front of the *Tribune* building was an enormous map of the United States. On the front of each State was a group of green and a group of red electric lamps, the green being the Democratic and the red the Republican color. As each State was carried by either candidate the lamps of the appropriate color were lighted. Other lamps on the map assisted to define and illuminate it. A sketch of the map and the arrangement of lamps is shown.

On many of the high buildings in Jersey City, New York and Brooklyn the progress and results of the election were shown by searchlights. From the Siegel-Cooper and the Manhattan Life buildings flashed the searchlight signals of the New York *World*. These consisted of flashing different colored lights to the different points of the compass, a green light being used when a Republican point was scored and a blue one when the Bryan forces came to the front. On top of the Rushmore dynamo works in Jersey City were 11 searchlights which were operated according to an extensively advertised code of signaling. The Madison Square Garden searchlight was operated by the New York *Herald*. A flash toward Harlem moved up and down indicated Republican gains; toward Brooklyn indicated Democratic gains; toward the east indicated the probability of a sound money Congress; toward the

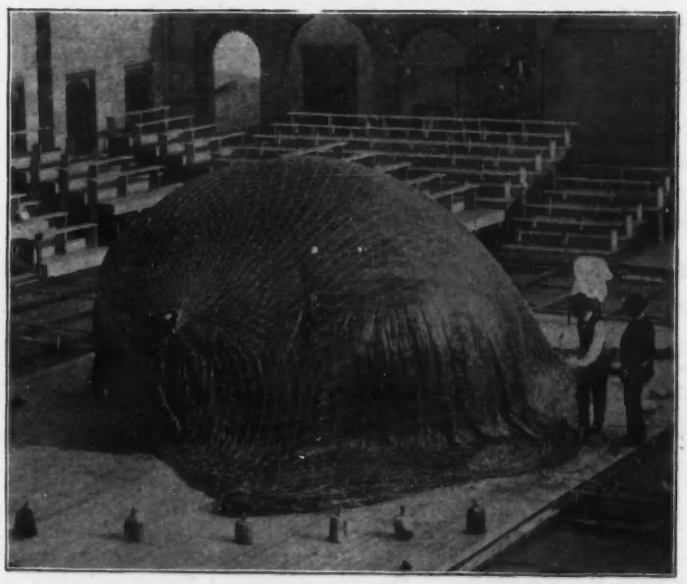


FIG. 3.—INFLATING THE BALLOON.

west the probability of a silver Congress. A steady light in the directions indicated showed that victory was assured, while a fluctuating light signified uncertainty.

Perhaps one of the most unique bulletin features was operated by

the *New York Journal*. On the top of the Grand Central Palace at Forty-third Street a large balloon of 21,000 cubic feet capacity was sent up to a distance of 500 feet and held there. A bamboo frame such as is shown in the sketch (Fig. 3) was outlined with fifty 50-cp white lights and represented the Democratic star. In the cen-

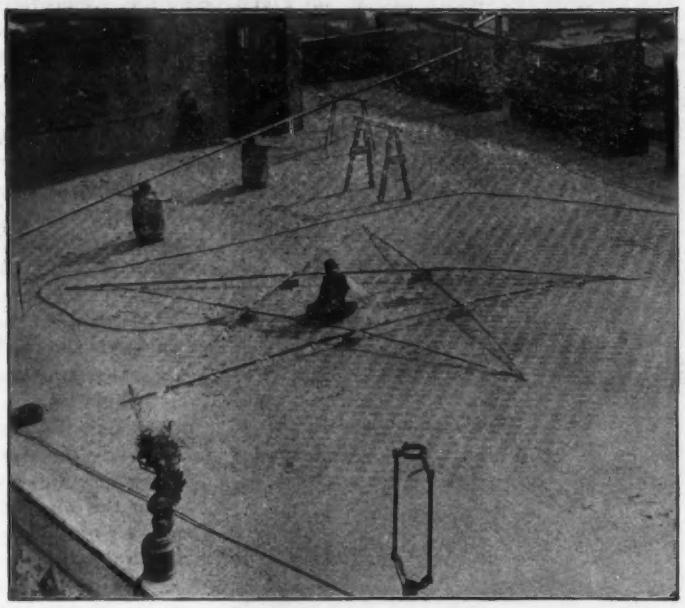


Fig. 4.—Constructing the Star.

tre were two 250-cp lights, one red and one green, which were used for signaling the results of the election. The entire weight of the star was 50 pounds, and that of the wires a little over 100 pounds. The balloon carried this weight into the air for a distance of 500 feet. Four Habirshaw insulated wires fed the system of lamps, and in order that the signal lights could be independently controlled a piece of lamp cord was run up to them. The principle was as follows: The two wires on either side carried the majority of the lamps on the star and the two signal lamps were connected each with one terminal of the lamp cord. The other terminals of the lamp cord were switched onto one of the feeder terminals by single-pole switches, thus lighting the red or the green lamps at pleasure. The main wires consisted each of a No. 8 and a No. 14 wire. It was originally

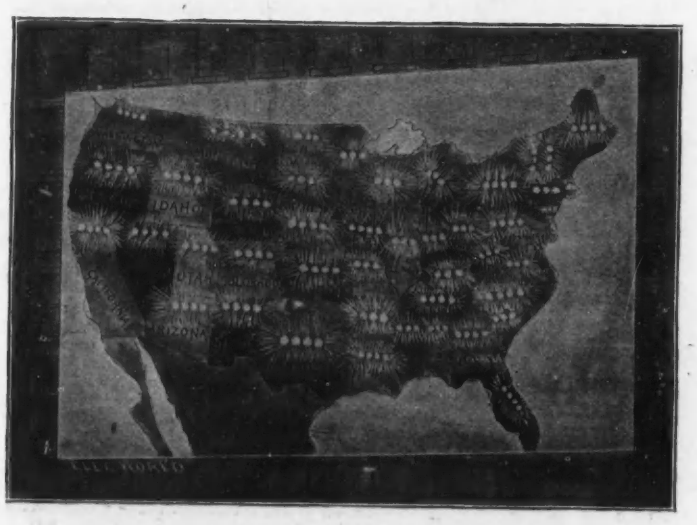


Fig. 5.—Map of the United States.

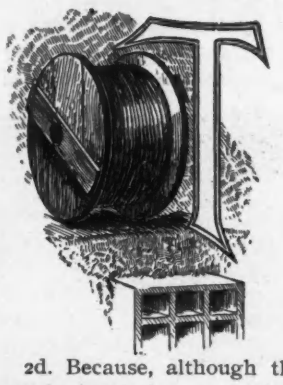
intended to supply the lamps on the 220-volt system and run them two in series, but the use of the Grand Central Palace at the last moment necessitated using a 110-volt system and the mains of No. 8 wire had to be reinforced by No. 14 placed in multiple with them. Perkins lamps were used.

Where Education Is Needed.

In a recent speech at Liverpool, on Technical Education, Mr. Preece made the statement that technical education was wanted more in the ranks of the employers than in those of the employed,

Insulated Wires and Cables, Their Construction and Design —Insulation; Its Efficiency and Defects.

BY J. DRAPER BISHOP.



THE following papers are intended to cover broadly the manufacturing processes of all kinds of cables at present used, as well as the principles governing their design and the value of their insulation electrically.

Deep-sea telegraph cables, however, I have omitted for two good reasons:

1st. Their construction, use and property are vested in the hands of a few corporations and so closely controlled that electrical engineers have but little interest in them.

2d. Because, although the general principles of ordinary gutta-percha insulation are quite commonly known, still the machinery, manipulations and processes, which are the result of great outlay and almost ceaseless study and experiment during the past quarter of a century, are secrets so jealously guarded by those within the charmed circle that neither myself nor any other electrical engineer outside can be fairly deemed competent to give any authoritative information on the manufacturing details of deep-sea telegraph cables.

But although thus debarred from writing on almost the only use of gutta-percha, there still remains a much wider and quite as important an area to cover in the field of wires and cables insulated with other materials, by different processes and for vastly different purposes. Of these, the most important are cables and conducting wires for arc-light and power, incandescent lighting, long-distance telephony and long-distance power transmission.

Any remarks on the wonderful extension of these applications of electricity are superfluous, but it should be better understood that full credit has not yet been given in the United States, to that part of the plant least thought and talked of, least cared for and least *en evidence*; that connection between the force and the mode of motion, the insulated cable.

It would be a difficult matter to collect statistics of the manufacture of cable in the United States, or a correct idea of the proportionate outlay for rotten and worthless stuff which many consumers have been glad to sell for old junk, but it is pleasant to think that as each of the past 20 years has added its quota of enlarged experience, the amount of "old junk" has diminished.

But it has not yet attained anything like so small a proportion as it should, and will never practically disappear until electrical engineers in charge of installations shall have a better appreciation than they at present enjoy of the principal factors which control the design and construction of cables to suit their particular current.

And that there are many very able men in charge of very important interests who possess an intimate and searching knowledge and experience of dynamos, motors and lamps, and yet really know nothing practical about cables, must unfortunately be admitted;

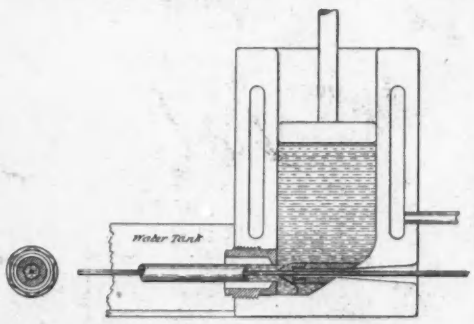


Fig. 1

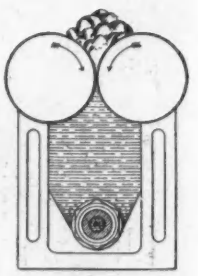


Fig. 2.

and I regret having to put such a cause forward as my justification for venturing to offer these papers for publication.

Cable Contracts.—It cannot be denied that the keen intellect of the scientist, the resources of the mechanical engineer and the enterprise of the capitalist, have all combined to develop working applications of electricity at a much more rapid rate than educated all-round electrical engineers can be evolved from what may be termed the working as distinguished from the theoretical and designing class. And probably this will be so until progress halts.

It is essential therefore for the united interests of both consum-

ers and manufacturers, that a spirit of mutual trust and confidence in each other's loyalty to the obligations of contracts should exist. It is to be regretted that such a spirit is not universal in electrical interests, but that, on the contrary, there is often shown a disposition to be "smart" or enforce "sharp practice" up to the borders of dishonesty, and from my own experience I am bound to say, that although the manufacturer is, on this account, entitled to a great deal of sympathy, his over eager competition for work at a barely paying price is one great cause of the excessive infliction of penalties and undue stretching of the meaning of contracts by which the consumer binds him to an already over-stringent specification.

There is a great deal to be said on this subject which is not always

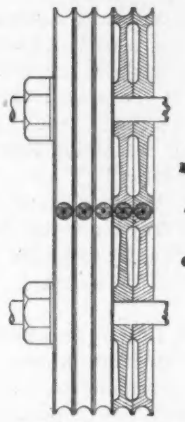


FIG. 3.

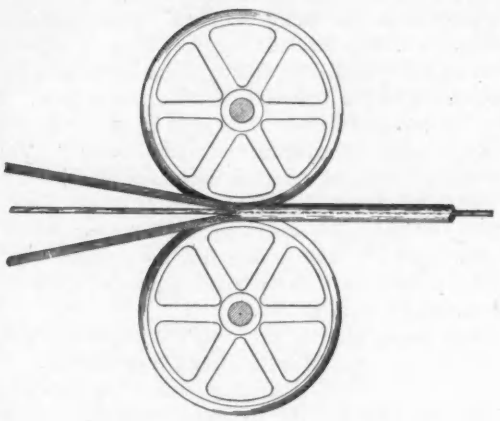


FIG. 4.

to the credit of the consuming corporation, but perhaps this is not the proper place.

However, while on the important subject of contracts for cable, it is within the scope of this paper to suggest that the engineer would often better serve his own credit and the interests of his company, if he refrained from drawing up amateur specifications for the guidance of manufacturers with half a life's experience in cable making. It is safe to say that the most trying part of a cable manufacturer's work is that of making an electrically safe and mechanically good cable, without too wide a divergence from the specification he has to bid upon, or else let his hands and machinery remain idle.

It is greatly to the manufacturer's credit that he does not more often retaliate on the consuming corporation by "smartly" bringing "sharp practice" to bear on the literal interpretation of certain clauses, the advantage offered him by loose and ambiguous expressions, or the impracticable if not impossible requirements of a specification which the engineer esteems as a technical production which the more nearly approaches perfection, as it bristles with restrictions, demands and penalties.

Instead of attempting to define and design a cable, the physics and mechanics of whose construction he is utterly ignorant, it would be far better for all concerned, and would reduce the quantity of old junk to a minimum, if the engineer applied to some well established cable maker of good reputation, and, frankly stating his ignorance as well as his requirements, left to the honesty and good faith of the cable maker to give him a first-class article at a fair and remunerative price. No manufacturer would risk his good name for square and honest dealing by taking a dishonorable advantage of the engineer's confidence, or if he did he would doubtless never get a second opportunity.

According to the present practice, the engineer often evolves, from scraps of information gathered from chance sources, cemented into a whole by his own idea of what his cable should be, a specification which perhaps no machinery at present in existence could possibly meet. This specification is then sent out broadcast among the cable makers and the so-called cable makers, and a general scramble ensues to obtain the contract on bids, some of which are not based on a fair and intelligent conception of the real needs of the engineer, but on the reduction of cost made possible by cutting down, ignoring, substituting and in fact taking the fullest advantage of any and every possible loophole, omission or doubtful meaning in the specification.

A bid, in ninety-nine times out of a hundred the lowest, is accepted, and the contract awarded to some shoddy manufacturer at a price far below that of his honest and fair-famed competitor. And sooner or later within short limits, the "junk heap" receives another additional proof that ignorance is costly.

To say that the alternative to this course suggested above, viz., the abandonment of the advertising for universal bids and the application direct to one or two good manufacturers is impossible, is to argue that we are less remarkable for good faith and honesty, and less careful of our reputation on this side of the Atlantic than are our brethren on the other, who commanded the confidence of American millionaires to such an extent, that cables costing millions were ordered, constructed, laid and worked on simple mutual good faith, and paid for as one would in ordinary circumstances order and pay for a suit of clothes. And no hint has ever reached our ears that such confidence has been regretted on either side. Is there any good reason why American electrical interests should be second to such a sterling proof of the power of an honorable name?

Leaving the commercial side of the question, I think that the electrical qualities possessed or required by insulation and insulated cables will perhaps be better understood and appreciated if we first describe briefly the physical nature and qualities of the various insulating materials, as well as the organic and mechanical working processes involved in their application to the conductor.

INSULATED CABLE.

An insulated cable consists of three distinct parts, each calling forth distinct and separate industries. They are the conductor, the insulation and the outer armor or protection.

The Conductor.—This is invariably of copper, but so much correct information already exists on this subject that further notice is unnecessary.

On concentric cables, however, there is undoubtedly good reason to say more further on, both in their own defense and also in defense of the little way they have made, and probably ever will make, in America. But this can best be considered when treating of insulation.

The Insulating Material.—The best insulating materials known for flexible conductors are: Gutta percha, india rubber and its compounds, vegetable fibre and compound, and paper.

Gutta Percha.—As already premised at the beginning, there is little left to say about this gum—discovered or at any rate first publicly produced in 1822 by an Englishman, Dr. Montgomery—in Singapore. As it softens at 122 degrees Fahr., and at 212 becomes adhesive, and there being no known treatment which remedies these failings, its use is confined entirely to submarine work.

It has a very high insulation resistance, which improves with the lower temperature and higher pressure of deep sea water. Its specific inductive capacity is a drawback, being 4.2. It oxidizes very readily by exposure, but seems everlasting when kept under water or encased in lead. It is not fit for insulating cables carrying heavy currents. Notwithstanding this, the general practice adopted for

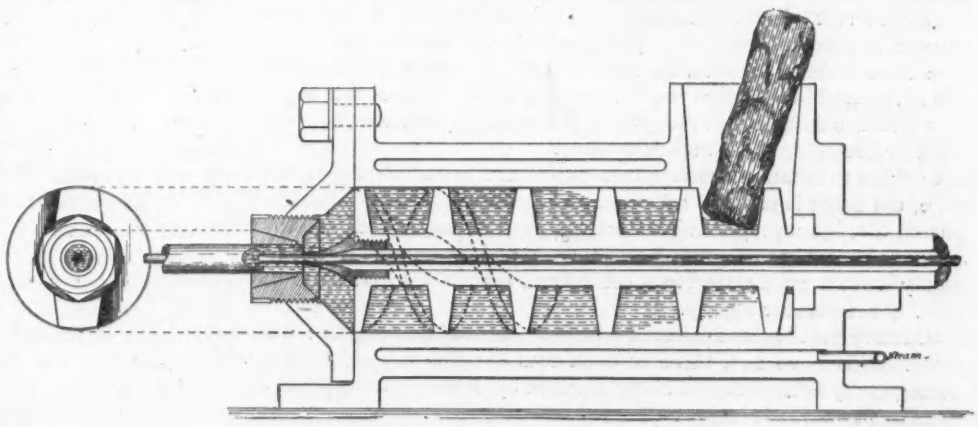


FIG. 5.

making ordinary gutta percha insulated cable may be of interest, and I here give it in brief, without pretension that it is, by any means, more than the common method.

Gutta percha comes principally from Sumatra and the islands of the Straits Settlements. It is very little used outside of England, whose consumption in 1890 was 68,640,000 pounds, out of an estimated total production of 85,800,000 pounds.

The gutta percha is shipped in cakes or balls of various sizes, and, as it is bought from the natives by weight, the ingenuity of the wily Asiatic is at its highest development in the art of substitution, adul-

teration requiring too much effort. The lumps of stone, wood and other foreign matter, used to give the native trader the best of the bargain, are a great source of expense and annoyance to the manufacturer, being destructive of machinery and temper. But when pure, gutta percha weighs about 60 or 61 pounds to the cubic foot. being therefore somewhat heavier than rubber.

It is but slightly elastic, although it may be stretched to two or three times its length before it finally breaks. Its tensile strength is about 3500 pounds per square inch. When cut or torn apart it will not reunite without the aid of heat, and unlike its rival, india rubber, does not lose any of its leading characteristics under repeated meltings and coolings. Exposed to the air and light, its essential oil oxidizes and evaporates, leaving behind it a brittle and friable matter of a resiny nature.

Gutta percha insulation should therefore be kept not only from the influence of the atmosphere, but also of light, which is best accomplished by its being placed under water, where it keeps good and sound indefinitely.

The processes by which the dirty lumps of native gum are prepared for insulation are as follows:

It is first chopped up by revolving knives or is torn to pieces by rollers with projecting teeth under boiling water. This process is repeated or continued until all the coarser matter is eliminated. The gum is then removed and placed in cylinders with perforated bottoms, covered with wire cloth sieves, through which it is forced by powerful rams.

After passing through a set of rollers whose object is to form the filtered gum into a compact and homogeneous mass from which all air and moisture have been excluded, the gum is ready for use. It is used pure, no process equivalent to or in any degree resembling vulcanization being known.

There are two methods of applying the insulation. The original one (see Fig. 1) still used in factories not "up to date" employs a cylinder, steam jacketed, charged with general potential, which, by means of a ram worked by a screw or other power, is forced out through a circular die which defines the thickness of the insulation, the die being fitted with a nozzle through which the wire passes. This process is of course intermittent, and requires a "wait" until the ram is lifted from the cylinder and the cylinder refilled, during which time all hands are idle and the short length of wire near the die become too soft. This process is also open to the objection that it allows admission of air with the charge of gum and entails its consequent expulsion with the insulation, in the shape of air bubbles, which of course are highly detrimental.

The latest and most perfected method is that by which the gum is forced into a chest or case by a pair of cylindrical rollers revolving in opposition to each other and but a very slight distance apart. (Fig. 2). This chest closely fits the rollers all round and affords no exit for the gum save that offered by the dies, of which there may be almost any number desired. By this means the air is effectually excluded and continuous insulation ensured.

In both methods the general potential is maintained at the exact degree of plasticity required, by the aid of steam heat applied either in coils or jackets. In both, the insulated wire as it emerges from the die is received in a shallow tank of running water whose length is not less than 100 feet, so that the general potential may become cool and solid before being wound up on the reel.

In order to obtain a firmer adherence of the gutta percha to the wire, the latter is usually, before entering the insulating machine, passed through a preparation whose composition varies with various makers; it consists of gutta percha, resin and Stockholm tar, commonly known as Chatterton's compound, patented so far back as 1860, if I remember rightly.

Ordinary gutta-percha-covered wire has but one layer of gum; the better kinds have two, three or even four coats or layers, perfect homogeneity between them being secured by intermediate applications of Chatterton's compound.

Caoutchouc or India Rubber.—India rubber has about half the specific inductive capacity of gutta percha. According to Schiller it is 2.34, but the addition of 1 or 2 per cent. of sulphur, as in vulcanizing, although the specific inductive capacity of sulphur is about 3.21 only, raises it to 2.94. The specific inductive capacity of ordinary cable compound varies with the nature and quantity of the adulterant, although not proportionately. Its specific gravity is .930 and the weight of a cubic foot about 58 pounds.

The supply seems to be well-nigh inexhaustible, as the India rubber-bearing plant is indigenous almost throughout the tropical zone. Its quality varies apparently more in proportion to the care with which the plant is cultivated and the juice extracted than to any botanical or climatic influence. The following description of the metamorphosis of the plant's milk into the rubber of commerce is taken from Chapsal: "If the milk is spread in a thin coating over a smooth surface it dries, forming a whitish skin or sheet elastic and semi-transparent. In greater quantity and exposed for several hours to the air, it separates into two parts, one solid, the other liquid, in the following manner:

"If a receptacle of the milk be allowed to settle, filaments are formed which are lighter than the rest of the liquid. These ramify, entwine with each other, combine and consolidate, forming a kind of cream.

"Throughout the whole mass the caoutchouc separates itself from the liquid in the same manner—the filaments interweave, arrange and squeeze themselves together, thus imprisoning a certain quantity of the liquid, and shortly there forms a layer more or less thick according to the richness of the milk in gum. If the solid matter is removed and drawn off, it soon hardens, becomes elastic, and is in fact the pure caoutchouc, or 'india rubber.' The remaining liquid is thick, has a bad smell, is useless and is thrown away."

This solid matter is folded up in layers like cloth, or rolled up in balls, in which the layers are still evident when they reach the factory. As they become dry and the surface oxydizes by exposure to atmosphere, the creamy color is gradually replaced by a dark gray turning to a dark brown.

The finest quality of rubber is imported from Brazil (Para) and the lowest from Africa (Small Ball-Accra). But from whatever source, the marked characteristics of the pure gum remain the same; these are its elasticity, its imperviousness to water and its peculiar property of homogeneous reunion, under slight pressure when broken or torn apart, or when divided by a clean sharp knife, all of which properties it retains even when adulterated with the incorporation of some 70 or 80 per cent. of foreign matter, though of course to a lesser degree.

Under the action of heat it begins to lose its elasticity and becomes viscous at 280 degrees F.; it melts at 360 degrees, and on cooling does not regain either its elasticity or its other original properties. If submitted to low tempertures it begins to lose its elasticity and become solid at 38 degrees F., and at 25 degrees F. is as tough as an old piece of cowhide, in which state it requires submission to a temperature of 100 to 110 degrees F., to restore its elasticity and other original properties.

Pure rubber is not soluble in but absorbs alcohol, under which it softens and swells. It is soluble in ether, chloroform, naphtha, petroleum, benzol, bi-sulphite of carbon, turpentine, etc., and it mixes or combines under heat with linseed oil.

Pure Rubber Insulation.—The first piece of rubber the writer ever saw applied as insulation was in 1856 or 1857 in London, and was the first attempt of the Silvers, founders of the great Silvertown cable factory of England. It was laid on in a spiral tape with overlapping layers. But the tension with which it was applied made it sufficiently waterproof to withstand the highest tests known at that time. No great improvement seems to have been made in its application since then, doubtless on account of the expense and risk of loss of insulation attendant on its use. Under the tension necessary to render it absolutely waterproof, a very small puncture becomes stretched out into a large one, and should this finally cause the strip to break, the spirals, under the influence of elasticity, unwind or loosen back for a considerable distance. It is now rarely, if ever, used save for lamp cords and similar purposes.

There is also a process by which a strip of pure rubber is laid longitudinally about a wire, which is then cut off close to the wire by revolving shears, and the edges closed down on each other by the pressure of rollers following the shears. But this has the disadvantage of a continuous seam, or liability to defect. Sometimes a rubber solution is also applied to the newly cut edges to aid in reunion, but this process is uncertain. If the solution is applied too plentifully or is too strong it "cuts into" or dissolves the adjoining solid gum; if applied insufficiently or in too weak a solution it does no good—in either case the joint opens under the strain of flexure.

(*To be continued.*)

Ohm Memorial.

It is proposed to erect a monument over the grave of the famous physicist, Georg Simon Ohm. The expense will be met by subscriptions, and the Konigliche Filiabank, Munich, is prepared to receive contributions for that purpose.

Telephone Repeaters or Relays, and Repeating Systems—I.

BY THOMAS D. LOCKWOOD.

THERE is nothing more easy than to invest a very ordinary achievement with a fictitious glory, or to hedge round a commonplace operation or device—especially when it relates to any of the applications of electricity—with such a glamor that it is enabled to assume all the consequences of a material advance in the art which it concerns, or of a really great and important improvement; and this even when the same operation is one transacted daily in commercial life before the eyes of those who choose to see; though the same device be 50 years old, has had its day, and has been left behind by its own children in the never-ceasing march of progress.

It is the year of grace 1884. A new telegraph company has built between the metropolis and the West a magnificent new circuit having a compound line wire of copper and steel. Smith, Brown, Jones and Robinson are the inventors of a like number of supposedly new telephone transmitters, each thought by its creator to be the most marvelous thing of the kind on the face of the earth, and to have powers of transmission simply illimitable.

These gentlemen are permitted on successive days to test their respective instruments on the new circuit, and possibly to the surprise of the experimenters, they all work over many miles of line fairly well.

Neither of our friends know of the trial of the instrument of the others, but each having a friend on the staff of some newspaper, trumpets forth by the kind assistance of that friend and newspaper the tremendous and unequaled merits of the transmitter in which he is interested; and if he trumpets sufficiently loud and long, and at sufficiently high frequency, other newspapers presently echo the cry; and bye and bye perhaps an electrical journal, on the principle that where there is so much smoke there must be some fire, timidly devotes a 20-line notice in small type to the best trumpeted transmitter of the four; while some enterprising rival of this journal, making amends by its ultimate energy for its relative dilatoriness, comes out the following week with a graphic illustrated account of the instrument, its extraordinary capabilities and its total dissimilarity to everything which has gone before, together with a picture and a biographical sketch of Robinson, or, as the case may be, that one of the quartette who has made the most noise.

But when we go behind the returns and get at the facts, and a truthful statement of them, we find that none of the four instruments is any better than the others; that all of them have but a fair degree of merit; that their subsequent glory is trumped up; that such success as was attained in the experiments was really due to the high character of the line conductor over which the trial was made, and that with a perfect circuit of moderate length any reasonably good instrument would give reasonably good results.

Another and more recent illustration of the unthinking and unreasoning way in which the newspaper press of the country will indulge immoderately in hysterical enthusiasm about any electrical proposition, however antique and however wild, and without waiting until it is put into effect, is one which occurred as lately as March and April of the present year.

This time it was a system of telephony for the electrical transmission of speech "from one hemisphere to another." The inventor who thus proposed to achieve immortality was one Clark D. Vaughn, said to be 35 years old and to have been employed by the Western Union Telegraph Company for 15 years.

The New York *World*, which seems at present to make something of a specialty of electrical canards, was the first to blazon forth the record-breaking feat still to be accomplished, and on March 27 published the sayings of Mr. Vaughn, to the effect that he had been working on the problem for 10 years; that he had now constructed his instrument and tested it up to 1500 miles, and that he had protected his invention by an application for letters patent.

The account goes on to depict Mr. Vaughn as further saying: "The voice sound transmitted through my new instrument between New York and London will be quite as distinct as is now produced between New York and Albany, without any of the singing, buzzing or humming noises so often heard on an ordinary telephone."

The *World* backed up this manifesto on the Sunday following by a second one, illustrated by a picture of Mr. Vaughn, which apparently had not been ready for the first.

The second article contained a statement that Mr. Edison discountenanced the practicability of any such invention, and the rejoinder of Mr. Vaughn, and wound up with the following naïve and highly scientific remark: "The great difficulty encountered hitherto in attempts to telephone over wires laid in the water is the amount of induction occasioned by the earth current, *and by substances which cling to the wire or cable.*" This difficulty Mr. Vaughn says he has overcome.

This wonderful invention speedily ran its course through the newspapers of the country, getting as far West certainly as Nebraska, and in due season was fittingly commented upon by the electrical journals; but notwithstanding the coruscational career of its story and claims, has since the month of April been heard of no more.

Many of our city newspapers now have an electrical column, which appears at least once a week, and which apparently is not a difficult one to fill, since judging from the usual character of its contents the editor is merely required to cull such matters from his technical exchanges as may seem to his ingenuous mind interesting; to transmute them into words of his own vocabulary, and to incorporate with them such sapient comment as his own individuality may dictate.

The Boston *Transcript* has such a column, generally reserved as a species of *bonnebouche* for its Saturday issue. This column recently asserted that "the great problem of transmitting images by electrici.y has been solved," and ascribed such solution to Charles B. Davis, a chemist of New York, who is represented as having stumbled, after two years of experimentation, upon crystallized selenium; the only substance which, to quote Mr. Davis, is "sensitive to light, and which remains quiescent in the dark; a substance that would when in an electric circuit transmit a current proportionate in strength to the amount of light that fell on it."

Mr. Davis is said to have given a detailed description of his apparatus, from which it appears that a single wire extends between the transmitting and receiving stations, which wire at both termini connects directly with a bunch of about 200 wires, all insulated from each other and all tipped with selenium at their ends. These at the transmitting station project into the back of a camera, and at the receiving station are caused to impinge upon a sheet of sensitive paper backed by a copper plate through which the current passes.

It is not evident why the terminal bunch of wires should be insulated from one another, since they all merge into the main wire; and on being asked how the merged currents divide themselves again properly at the receiving station, we are told that Mr. Davis in accents of conviction-compelling candor said: "I don't know; I only know that they do. Electricity is like all natural phenomenon (*sic*); we know only the results, without comprehending how nature reaches them. Your question involves one of the many mysteries of electricity. But the fact that my apparatus takes up these separate impressions, and that one wire carries them and separates them at the other end, is no more strange than the everyday occurrence of transmitting simultaneously several telegraphic messages over the same wire and in opposite directions. I know the fact, for I have had the result." Mr. Davis says that he has operated his invention over 100 feet of wire, and repeats the threadbare fallacy that "100 feet establishes the fact as well as 10,000 miles would."

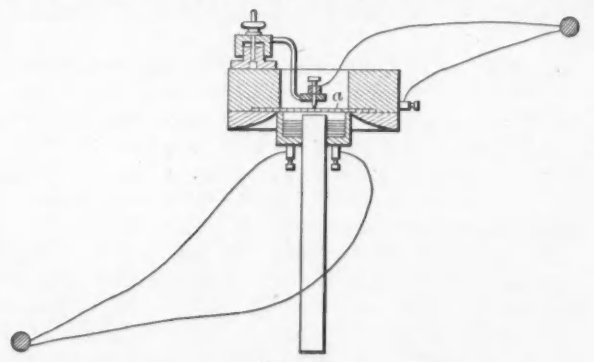


FIG. 1.

It is really pitiful at this stage of the history of the telegraphic art to think of this inventor painfully experimenting to find at the end of two years what, by looking in almost any textbook, he could have ascertained before he began, *viz.*, the fact that selenium was sensitive

to rays of light, that its resistance was variable under variations of light, and that everybody who has considered the subject of electrically transmitting pictures or scenes has also contemplated the use of selenium and has recognized it as promising more than other substances in this branch of work.

But the amateur inventor of electrical processes will not read, being evidently afraid that he will find out that what he is trying to do has been done before. So hiding his head, ostrich-like, in his own experimenting room he blunders along, lauding himself, if he has luck, in a fool's paradise, the blissfulness of which reaches its climax when his secret, confidentially imparted to one or two friends

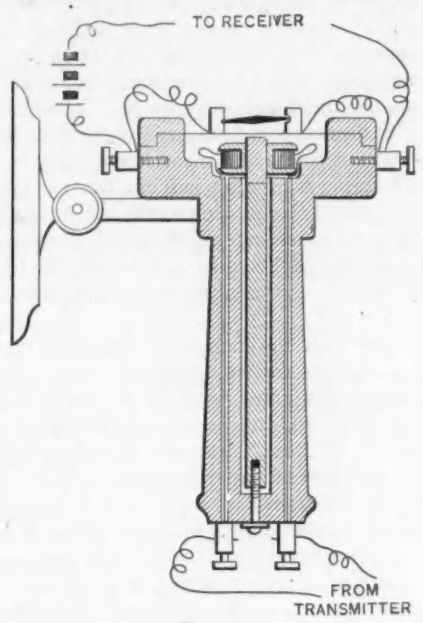


Fig. 2.

and by them to theirs, ultimately reaches the friend who reports for the newspaper.

In the early part of September last a press despatch from Europe appeared in some of our morning newspapers to the effect that a Russian electrician rejoicing in the euphonious appellation of Kildischewsky had devised a new telephone which defied the limitations of distance, and with which, after meeting and vanquishing the enormous distance of 1340 versts (which we are kindly told equals 890 English miles) the inventor was now looking for other worlds to conquer and would shortly be heard from by way of the transatlantic cable, over which he would essay to talk from London to New York.

The New York *World*, as becomes the champion of transatlantic telephony, forthwith assumed a bold front and on Sept. 14 published a leading article entitled "A New Telephone Discovery," which refers to the supposedly marked advance registered by the Russian invention; assumes that the said invention consists in an automatic telephone "relay" or repeater," and launches out into a sea of imaginary benefits possible to accrue from the important invention.

These publications were succeeded by the usual running fire of press notices, and later by a series of commentaries, remarks and brief interviews in the electrical journals. Some of the several accounts given by the achievements of the Russian gentleman and his telephone are interesting; all are entertaining, and they naturally vary in details, which in a few of them are multiplied, presumably on the Pooh-Bah principle of adding corroborative color and vitality to an otherwise bald and uninteresting narrative.

One account goes so far as to prophetically transform the inventor's name to Keldushoffsky.

We may, however, deduce from a comparison of the different accounts that the common source of their information contained the following statements:

The experiment was performed between Moscow and Rostoff, on the Don.

The distance between these towns is about 900 English miles.

The wire used was a telegraph wire and was over 1800 miles long, and

That a newspaper man, the representative of the Moscow *Gazette*, witnessed the experiments.

But measurements made on a map drawn to scale indicate that the direct distance between Moscow and Rostoff, which is a town some 20 miles above the mouth, at the Sea of Azof, of the Don River, instead of being 900 miles is but little over 600 miles distant from Moscow.

And keeping this and the above recited facts in mind, we may, without straining our material, piece the story together thus:

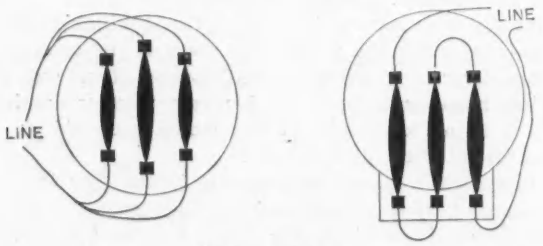
Kildischewsky has devised a form of transmitter which, as it has given good results at his home, end on short lines round Moscow, he is desirous of trying on a long line.

He finds out that the longest line to which he can obtain access is one which extends from Moscow to Rostoff, doubled by being looped at the latter place. Here we have a distance of something upward of 600 miles direct, lengthened out to some extent by the route of the telegraph line, but probably not made as long as the 900 miles reported, and then doubled by the addition of the return wire, so that if these hypotheses be correct the greater distance mentioned (1800 miles) is only made by taking the sum of the lengths of both wires of the loop.

Russia is a progressive country in the matter of applied scientific research, and in electrical apparatus, circuits and operations has always kept well to the front. Its telegraph system is well spoken of, and since the material of the "ordinary telegraph wire" is not particularized, we may consider that its chances of being made of copper are at least as good as those which argue for its having been iron.

It is not surprising that a representative of the press witnessed the experiments. Where are not the representatives of the press? We must not, however, expect too much from the "representative of the Moscow *Gazette*," who is not likely to have been either an electrical expert generally or a telephonic expert; and indeed, from the brief accounts which have reached us, we are not justified in concluding that M. Kildischewsky himself knows much about telephones or has had much telephonic experience. It cannot be imagined if he had that he would on the strength of a successful long-line experiment talk about carrying his transmitter to London for the purpose of using it in transatlantic cable transmission, it being an almost rudimentary proposition that the problems of long-cable transmission depend mainly on conditions of the conductor and not upon those of the instrument, and that as a consequence such conditions cannot be altered by changes or improvements in the instruments.

It is therefore not an unfair assumption, that hearing at one end of a loop, good reproduced talk coming from the transmitter at the other end of the loop, M. Kilkischewsky and his friend, the newspaper man, jumped to the conclusion that the very ordinary feat in telephony, performed under very ordinary conditions of the circuit, was an extraordinary one, performed under extraordinary conditions, simply because feat and conditions alike were extraordinary to them; and that a transmitter which could, under any conditions, talk over a distance of 1800 miles of wire (adopting the highest figures) might certainly be depended upon to talk well between Europe and America, even though the distance, straight out, were twice that of the double wire of their experimental loop; and notwithstanding the wide difference in the electrostatic capacity of the two circuits. Such logic of course is not applicable to the ordinary



Figs. 3 and 4.

events of life, and nobody expects because a man may be able to jump 10 feet on the level ground, that he is therefore capable of jumping 20 feet up into the air. But, on the other hand, nobody expects an enthusiastic and rather ignorant inventor, with an equally enthusiastic newspaper friend, to employ the logic of reason and common sense.

As a matter of fact, the most liberal understanding of M. Kildischewsky's achievement, as reported, shows it to be insignificant by the side of the every-day work of American long-distance lines, by means of which daily conversations are maintained over distances between cities of 1000, 1400 and 1500 miles of line, which distances, since two wires are employed, of course involve the use of and transmission through twice the length of line-wire. Experimentally and

for testing purposes circuits over 2000 miles long are not infrequently made up and satisfactorily operated, quite as a matter of course, and with no thought of the performance of great feats which deserve to be chronicled by the newspapers of the world.

I do not know that there was anything in the original telegraphic reports of the experiments with M. Kildischewsky's telephone suggesting the use of a "relay" or a "repeater," or how and on what grounds the idea that one was used has become prevalent, and it is not quite clear why anyone wishing to talk telephonically over a wire 1800 miles long should trouble himself with the additional complexity of a relay, when the thing can be done so easily without one.

A good deal of interest, however, attaches to the general subject of telephone repeaters ; chiefly, I apprehend, because it is thought that in this branch of telephonic work we still have something which has not reached fruition ; and whether our Russian inventor has one or not, the ingenious supposition that he *may* have used one is sufficient reason and text for the following portion of this screed, which lays no claim to any degree of authoritativeness, is not *ex cathedra* in its utterances, and does not assume to be by any means the last word to be said on the subject, but simply expresses the present and absolutely personal views of the writer.

The terms "relay" and "repeater" as used in telephony are of course drawn from the terminology of the elder art of telegraphy, in which, oddly enough, the former at any rate has always been misapplied. It will be remembered that before Morse had ascertained experimentally that by the use of electromagnets wound with a great deal of fine wire his telegraph could be made operative upon long circuits, he contemplated a successive series of short circuits, each after the first being controlled by the register lever, whose electromagnet was connected up in the preceding circuit, the said lever acting as an automatic key.

Each of these short circuits was intended to have its own battery, so that by these constant additions of fresh battery power the current in the last section of the line would be maintained as strong and as fresh as that at the sending end. (See Example 11, Morse patent No. 1647, June 20, 1840.)

The term "relay" applied by Mr. Morse to this feature of his invention is attributable to the analogy of the idea to that of renewing or relaying the horse-power furnished at certain stations on regular stage coach routes, and this analogy was doubtless impressed upon the mind of the inventor the more strongly in view of the circumstance that in building his earliest line, the first important station out of Baltimore, was one so intimately associated with this staging practice as to bear the title *par excellence* The "Relay House" a title which, as every one knows, still exists, commemorating in the railway station at that point the former triumphs of the stage coach.

Morse's "relay" idea was never carried into effect, but when he introduced the receiving magnet and local circuit of his second patent, a device based on a principle in some respects similar to that of said relay idea, since in it a magnet in one circuit opened and closed a second circuit, albeit for a distinct purpose, the operators of that day being more practical than discriminative and quite disregardful of etymological propriety promptly applied the term "relay" to the receiving magnet, and as operators are a conservative and tenacious race "relay" it has been ever since, the strenuous efforts of Mr. Morse himself and others to the contrary notwithstanding.

And though the significance of the term has entirely disappeared, there is nothing for it but to accept the inevitable ; and the word "relay" is now, and will be to the end, an expression for an electrical appliance capable of responding to the passage through its coils of a current too weak to do the required work, and adapted to control a local circuit and thereby bring into action for the performance of such work a stronger current due to an independent source connected in the local circuit.

On the invention and introduction of that telegraphic device, which we know as a "repeater" and which more nearly is an embodiment of the earlier Morse idea, as it is placed at a station on one main circuit, for the purpose of so controlling another main circuit that the signals originally impressed upon the first circuit shall automatically be propagated over the second, the name "relay," which manifestly would here have been appropriate, was found instead to have been appropriated ; and a new name being therefore necessary, that of "repeater" was selected, and has been applied ever since to any organization of circuits and apparatus which, actuated by the changes of current in one main circuit, takes up these changes and transfers a copy of them to another main circuit, thus enabling a receiving operator for the first and a sending operator for the second circuit to be dispensed with.

The terms "relay" and "repeater" have both been passed along into telephony, there to describe appliances devised for the performance of the same functions which in telegraphy are assigned to their respective congeners, and a very considerable number of both classes of instrument have been proposed and contrived during the 20 years which have elapsed since the grant of the fundamental telephone patent.

There is, however, in telephonic practice no such sharp dividing line between relays and repeaters as exists in telegraphy, and such difference as does exist is not usually structural or fundamental, but is mainly one of use or result; in what follows therefore telephone relays and telephone repeaters mean generally the same thing, this plan of consideration being indeed made necessary by the circumstance that the contrivers and inventors of such apparatus have used the two terms indifferently. If, however, the reader wishes to preserve or maintain the old telegraphic interpretation of the terms, it may be once for all understood—although there is no vital difference in telephony between the appliances—that wherever either term is applied distinctively a relay is an instrument wherein the relatively feeble voice currents of a main line do not act directly upon the receiving telephone at the receiving station, but are utilized in producing corresponding voice-variations in a stronger current flowing in a short local circuit, which contains the working helix of the receiver; while a telephone repeater, on the other hand, is an instrument which is based on the same principles, and having substantially similar construction, is an instrument in which the main-line voice-current variations act to produce corresponding variations in a second main line leading to a distant station, where is located the telephone which ultimately is required to reproduce the original sounds; the second main circuit being provided with an initial source of current of its own.

Both relays and repeaters as above defined, usually act upon the second circuit by means of a suitable electromagnet in the first circuit controlling a diaphragm or armature, and a variable resistance in the second circuit, upon which the diaphragm or armature acts; so that we may now say that in both the changes of current produced in the first circuit by the operation of the home transmitter bring about a variation of the attraction exercised by the receiving magnet at the repeating or relay station upon its armature or magnet, and thus cause the same to vibrate; that the mechanical vibrations thus produced are impressed upon the variable resistance of the second circuit—whether local or main—and as the resistance is thereby varied in correspondence with the movements of the armature changes are set up in the current maintained in the second circuit by its independent source, and this current by such changes is transformed into a copy of the current of the first circuit, so that it must act upon any receiving telephone connected in its circuit in the same way as the original current would have done; and equally of course the said receiving telephone then utters sounds which are approximately a copy of the original transmitted sounds.

It is also to be pointed out that in either instrument the receiving magnet may without any change in principle act upon the second circuit (whether local or main) according to conditions either directly or through the intermediation of an induction coil and a primary-battery circuit, the plan ordinarily adopted in the connections of the original transmitter.

And generally, we may understand that while the object of the "relay," as we have distinctly defined it above, is to reinforce the effect at a final receiving station of the weakened arriving main line current by enabling it, with the aid of a new battery, to act more efficiently upon the receiver than it could when applied directly, and thus to reproduce speech at such station louder than otherwise ordinarily could be done; the object of the "repeater," also as defined above, is not in any sense increased loudness, but is the satisfactory operation of the receiving telephone at a greater distance from the original transmitter, or over a longer line of communication than is otherwise ordinarily practicable; and the accomplishment of this by placing at an intermediate station, between the end of one circuit and the beginning of another, an instrument adapted to take up the current changes of the first circuit, and to impress them upon the steady current set up by a fresh source in the second, so that the current in the circuit comprising the latter half of the total distance may be enabled to act upon the receiver with greater vigor than it could if the transmitter and receiver were in a single circuit extending the entire distance.

It is now time to show that the broad class of telephone repeaters and relays includes one sub-class, which has been in practical and commercial use for many years, almost indeed since the advent of

the first battery transmitter. Though totally dissimilar in form to those we have been considering, the similar purpose of instruments of this sub-class and the fact that they are alike applicable to local and line work sufficiently discloses their relationship.

The sub-class to which I refer is that which includes the transmitter induction coil and the main-circuit repeating induction coil, and since instruments of this class are not within the range of our present subject, they require but brief notice.

The former kind of coils enables us to raise or lower potential as desired and to raise or lower the range of a transmitter as desired, and they therefore are convenient adjuncts to telephonic circuits; and we are enabled by the second kind of coils to connect a metallic circuit with a single-line circuit, or to connect any two circuits together, and these likewise are therefore very convenient.

But their use cannot add anything to the stock of energy at our disposal, and they are no aid in solving the problems of telephonic transmission over unusually long distances. It is, however, interesting to note in passing that a number of repeating coils may be used to link together inductively a corresponding number of successive circuits, a transmitter being connected with one of the terminal circuits and a receiver with the other, and that if the several circuits are not very long, as, for instance, when all are in the same laboratory, the speech transmitted will be reproduced apparently as well and as clearly as it would have been had no such repeating coils been interposed, which perhaps indicates that in telephonic work, at any rate, a laboratory experiment is not necessarily conclusive. I should not place much reliance upon the work of any telephonic improvement that had not been thoroughly tested on a real line and under commercial conditions.

To distinguish the telephone repeater as it is usually known from the repeating induction coil, I think it should be borne in mind that the former is an *electro-mechanical* repeater. When it is necessary to discriminate, this is the name which should be given to it.

The idea of the electro-mechanical repeater has always been a very fascinating one, and too frequently, no doubt, a very disappointing one, as there are a good many quirks in it, which only experiment can bring out. The simplicity of the underlying thought, which, briefly stated, is "to operate the transmitter of the second circuit by means of the receiver in the first," or as F. Jarvis Patten hath it: to hear—"speech in a second line that was automatically transmitted from the first by a repeating telephonic relay, the speech being delivered in the second line with all the distinctness and certainty of ordinary telephonic transmission"—has been a bait for a great many ingenious minds, who later have ascertained that something more than the possession of a first-class underlying idea is needful to make a first-class inventive success.

The telephone relay was one of the earliest subjects to which the brain and hand of the telephonic thinker and improver was turned; and as everybody who was anybody in those days (the halcyon days of from 1877 to 1879) was thinking about, and working at the telephone, we need not be surprised when we find that telephone repeaters of simple form were devised by a number of independent inventors.

Probably Mr. Edison first gave serious attention to the question. Certainly this is what we should expect, since he was actively engaged from a very early date in the invention and perfection of the carbon transmitter.

Accordingly we find an early published account of his pressure relay, in which carbon discs are placed between the poles of an electromagnet core and the armature, the carbon discs being in one circuit and the magnet helices in another. A cut illustrating this account shows the carbon in circuit with a Morse sounder, indicating its applicability to telegraphy; but the following pregnant paragraph leaves no room for doubt that the instrument was intended mainly as a telephone relay. We read: "The great difference between this relay and those in common use and its value rest upon the fact that it repeats or translates from one circuit into another the relative strengths on the first circuit. . . . It is probably the only device yet invented which will allow of the translation of signals of variable strengths from one circuit into another by the use of batteries in the ordinary manner. This apparatus was designed by Mr. Edison for repeating acoustical vibrations of variable strengths in his speaking telegraph." — (*Jour. of the Telegraph*, vol. ix., p 163.)

A few years later Mr. Edison in testifying in an interference case, spoke of this instrument, calling it his "telephone relay," saying that half a dozen of them were made, and that it was described in the article mentioned above.

The same distinguished inventor, as we shall presently see, gave further attention to this subject a couple of years later, and again when the art was more advanced.

It is worthy of note that the next word which history has for us concerning the telephonic relay is to be found in a German patent, No. 4000, granted Jan. 12, 1878, to Robert Ludtge, and entitled "Transmitter and Relay for Electric Telephones." This patent is remarkable as anticipating the disclosures of Hughes, and describes a metallic-contact microphone operated by variations in the intimacy of contact between its two electrodes; and also a relay in which a magneto-telephone in one circuit with a distant transmitter operates a microphone included in a second circuit with a second receiver.

The relay portion of this patent is shown in Fig. 6 of the drawings which is reproduced here as Fig. 1, and in a translation of the specification, the microphone is first described, and the relay is then mentioned in the following brief statement: "It will be clear from what has gone before that all constructions mentioned will fit the transmitter for use as a relay, as Fig. 6 shows."

In this case the plate *a* is identical with the iron plate of the Bell telephone only it is set in vibration now, not directly by the voice but by inductive and magnetic forces operating below it called into action by the transmitter, and then propagates the vibrations received at the receiving station as a transmitting apparatus would do."

In the claim of the patent the principle and structure of the microphone is recited and the statement is made that it "can also be used as a *relay* in telephone establishments."

After the first announcement of the microphonic researches of Prof. Hughes we find Profs. Houston and Thomson associating the unstable contact microphone with the magneto-telephone to provide what they declare they have "since the announcement of the Bell articulating telephone" been endeavoring to devise "means by which the telephone might be relayed."

This device appears to be described first by a letter to *Nature* signed by the inventors and dated June 7, 1878 (*Nature*, vol. xviii., p. 194, June 20, 1878.) An illustrated description is also given by the authors in the July, 1878, number of the *Journal of the Franklin Institute*, the same article being also published in the August, 1878, number of the *Telegraphic Journal*, London.

Figs. 2, 3 and 4 are reproduced from the illustration used by both periodicals and graphically show the construction of the device.

The Hughes microphone of the picture is attached directly to the outer face of the magneto-telephone diaphragm, and is a very small one, consisting in the principal figure of two carbon blocks and a carbon pencil whose pointed ends rest loosely in cavities in the blocks.

The two other figures represent modifications thought to be more appropriate for certain conditions, in which a number of simple microphones are wholly mounted on the diaphragm in parallel, as in Fig. 3; or partly so, and in series as in Fig. 4.

The inventors remark that "the message so relayed or repeated, for it is evident that the instrument can be used either as a relayer or repeater, may be either received at once by a telephone placed in [the second] circuit, or may again be repeated in a new circuit." (*Journal of the Franklin Institute*, vol. cvi., p. 51, July, 1878. *Telegraphic Journal*, London, vol. vi., p. 343, Aug. 15, 1878.)

There is good reason to believe that Prof. Hughes perceived that such a use might be made of his microphone, at least, as early as the time of his first public statements, and indeed the application was so obvious a one to any one giving thought to the subject that there is nothing surprising in the circumstance that it should occur to several experimenters at or about the same time.

Accordingly, on June 8, 1878, just one day later than the date of Houston and Thomson's letter, Prof. Hughes read a paper before the Physical Society in which appears the following paragraph: "I have recently made the following curious observation: A microphone on a resonant board is placed on a battery-circuit together with two telephones. When one of these is placed on the resonant board a continuous sound will emanate from the other. The sound is started by the vibration which is imparted to the board when the telephone is placed on it; this impulse passing through the microphone sets both telephone discs in motion; and the instrument on the board reacting through the microphone causes a continuous sound to be produced, which is permanent so long as the independent current of electricity is maintained through the microphone. *It follows that the question of providing a relay for the human*

voice in telephony is thus solved." (London, Edinburgh and Dublin *Phil. Mag.*, vol. vi., July, 1878, pp. 44–50.)

Prof. Hughes was too sanguine. The phenomenon he described is (as those familiar with the subject will readily recognize) substantially identical with that re-discovered by the electricians of the Long-Distance Telephone Company some years ago in which a jar given to the transmitter acts to produce a musical note in the receiver, which can be perpetuated by holding the latter near the transmitter mouth-piece, so that the vibrations of the transmitter diaphragm started by the mechanical jar are maintained by the impact of the sound-waves of the musical note ; which phenomenon is sometimes still used to ascertain whether the battery is sufficiently strong.

More than this was needed for the practical solution of the problem ; the repetition of a single note does not necessarily argue the practicability of the repetition of the complex and rapid changes o articulate speech ; nor does a laboratory result necessarily foreshadow a like result with a real commercial circuit.

(*To be continued.*)

Experiments on the Theory of Telephonic Sound.

BY RIUJI NAKAYAMA.

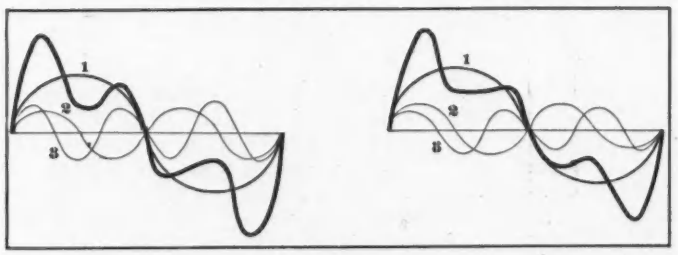
(*Concluded from page 562.*)

Experiments showing the influence of sympathetic vibration on the telephone sound have been made by Prof. Ferris, Lord Rayleigh,[1] Profs. Cross and Page, of the Massachusetts Institute of Technology.[2]

The sounds of human speech are naturally musical sounds; although consonants are characterized by very small noise, as already explained, so that, generally speaking, we may consider the sound of human speech as a combination of several simple harmonic motions, so far as the vowels are concerned, and we can decompose them into several simple harmonic motions having the ratio of 1, 2, 3, 4, . . . times the vibrational number of the fundamental tone according to Helmholtz.

The telephone diaphragm has a certain mode of vibration, a certain number of vibrations per second, and that serves to strengthen any tone that is spoken near it having the same or nearly the same number of vibrations, and thus that tone is made more prominent than some other tones. This action makes a deformation of the sound, but fortunately the effect is not to make the sound indistinct, but simply makes some sounds more prominent without weakening other sounds. In short, sympathetic vibration of the diaphragm has the effect only on vowels. It does not effect consonants, because they have no radical form of wave, but small characteristic noises which cannot produce any sympathetic vibration of the diaphragm.

To explain the effect of sympathetic vibration of the diaphragm, in the following figures the heavy line in the drawing denotes the sound wave and lines 1, 2 and 3 its components, having the respective intensities of 1, 2 and 3 (Fig. 1). If the vibration of the dia-



FIGS. 1 AND 2.

phragm corresponds to No. 3, then the No. 3 wave will be transmitted in greater strength than 1 and 2, and the resultant wave takes the form as in Fig. 2.

From this explanation it will be seen that sympathetic vibration has no effect upon the consonants, but only upon the vowels. The vowels have a particular note which is most predominant among the harmonics. For example, *u* has 175 vibrations per second and *o* has 466, *a* has 932 and so on. If the diaphragm has a vibration of its own of say 460, then the syllables which contain the vowel *o* will be exaggerated. The effect is only to exaggerate the predominance of the syllables containing *o*, and not to make them indistinct, except very, very slightly. Thus the effect of resonance has almost no influence upon the indistinctness of telephone sound. The indistinctness of telephone sound almost entirely comes from the cause given in the foregoing section.

(*d*) *Relation Between the Diaphragm and Timbre of Telephonic Sound.*—This depends upon the material out of which the diaphragm is made ; metal and wood each give a distinctive sound of their own. Therefore sound when transmitted by the telephone changes its quality in two ways : (1) Small waves are not transmitted, since the inertia of the diaphragm, as previously stated, changes their form. (2) The diaphragm gives its own vibration, which will modify the wave form. According to Helmholtz's theory of the timbre of sound, we can say that when the diaphragm gives very small

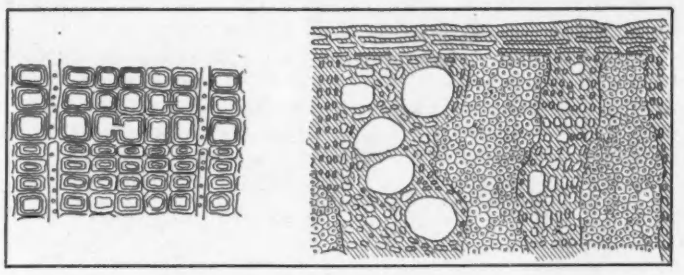


FIG. 3.

vibrations, as with a brass plate, the quality is changed and makes a shrill sound. When a wooden diaphragm is used it gives fewer vibrations and a dull sound results. This is proved by Prof. S. P. Thompson.[3]

Every diaphragm has its own tone. When this fundamental tone is low, the sound is *boomy*. If this fundamental note is high a *tinny* sound results.

(*e*) *Variation of Current in Primary Circuit.*—Another reason for indistinct telephone sound is that the current variation in the primary circuit cannot correspond to the amplitude of the vibrations of the diaphragm. The resistance does not vary directly with the pressure. This was shown by Mr. Bidwell.[4]

This effect is more remarkable in the Blake transmitter than in the Gower-Bell transmitter, so that, generally speaking, in the Blake transmitter loud speech may easily become indistinct, but this cause does not effect so much if moderately spoken.

IV.—THE IDEAL TRANSMITTER.

The Requisites of a Good Transmitter.—1. The diaphragm must be sensitive so that it can make vibrations corresponding to the sound-wave forms.

To satisfy this condition: (*a*) The diaphragm must be very small, light and flexible, so that it will have the least inertia and the least rigidity. (*b*) It must be very dense, so that wave sounds cannot pass through its pores. (*c*) The diaphragms must be of uniform tension throughout; otherwise it will make different vibrations arising from inequality of tension.

2. The diaphragm must not give its own vibration.

To avoid this is very difficult, because every substance has its own vibration however it may be supported or fixed; but this effect may be very greatly reduced by the mode of adjustment. If we wish to avoid the sympathetic vibration of the diaphragm, we must make its vibrational number under 80 per second or over 3000 per second, because the vibrations of human speech do not go as low as 80, and the wave above 3000 is very feeble. If we make the diaphragm under 80 vibrations per second it would be too thin. But, fortunately as before stated, the effect of sympathetic vibration is not very injurious to the clearness of sound. Its principal detrimental effect is not to make telephonic sound indistinct, but only to exaggerate certain vowels which have certain characterizing harmonics near to the vibrational number of the diaphragm. Mr. Mercadier, in his paper on the "Telephonic Reproduction of Speech," previously referred to, concludes that if we make the diaphragms over 1000 vibrations per second, we have avoided entirely the effect of sympathetic vibration. But this is not true, for, although the fundamental vibration of human speech is somewhat under 150 for males and 600 for females—hence it cannot make sympathetic vibration upon the diaphragm by its fundamental tone, yet the vowel *a* has characterizing harmonics which have vibrations of about 932, so that the diaphragm which has about 1000 vibrations per second may have some sympathetic vibration for the vowel *a*. Thus the syllable containing the vowel *a* will

[1] "Minimum Current Audible in the Telephone," *Philosophical Magazine*, vol. 38, p. 232.

[2] *Electrical Review*, Nov. 14, 1885.

[3] *Journal of Inst. of Tel. Eng.*, vol. 16, p. 46.

[4] *Journal of Institute Telegraph Engineers*, vol. 12, p. 204.

make sympathetic vibrations, and they are always transmitted stronger than syllables containing any other vowels by this diaphragm. The effect of the sympathetic vibration of the diaphragm is not detrimental to the distinctness of sound, hence we need not give any attention to this point, only considering the proper diameter and thickness. According to the paper by Mr. Mercadier, the diaphragm should be 100 millimetres in diameter and one millimetre in thickness, or should bear this relation to each other (that is, if the diameter is increased, the thickness should be increased). This sized diaphragm of steel generally has 900 or 1000 vibrations per second. The reason this diaphragm gives better results is not due to the 1000 vibrations per second, but is the result of the fact that its rigidity is adequate to respond to the vibrations of waves.

3. The amplitude of vibration of the diaphragm must be proportional to the amplitude of sound waves. In other words, the diaphragm makes vibrations corresponding to the amplitude of vibration caused by explosive voice or fricative voice. Most of the diaphragms from their construction exaggerate the vibrations for explosive voice more than for fricative voice, especially in the Blake transmitter, where the diaphragm is enclosed. The Gower-Bell seems preferable in that respect, as it allows the air a chance to escape.

This effect is generally reduced by increasing the thickness of the diaphragm ; but if we increase the thickness of the diaphragm, on the other hand, we must sacrifice the clearness of sound, as stated in the first condition. Thus Mr. Mercadier says, in a magneto telephone receiver, "The intensity of the sound is gained by sacrificing the quality of sound." This conclusion is true within a certain limit ; but if we increase the thickness of the diaphragm beyond a certain limit, we lose both intensity and clearness. As clearness and intensity are equally important in telephony, we must secure both, so that practically we wish to have as great an intensity as possible without indistinctness of sound.

4. The variation of current in the primary circuit must be proportional to the amplitude of the vibration of the diaphragm.

To satisfy this condition the contact carbon must be located just in the middle of the diaphragm. The results of mathematical investigation of this will be found in the Journal of the Japanese Electrical Society by Prof. Nagaoka, April, 1892.

In the Gower-Bell transmitter all carbon pencils must be light and equal in weight and the condition of contact points must be equal; otherwise they cannot correspond to the vibration of the diaphragm; the less the number of contact points the better the result. The result obtained by Mr. Bidwell was that the microphone carbon pencils must be great in number and put in parallel. This conclusion is for the purpose of getting the greatest variation of current. He also concludes that the weight of the carbon pencils must be considerable. This conclusion is not true from the point of clearness of telephonic sound.

(*b*) *Relative Merits of Metal and Wood as Diaphragms.*—Wood, even though very dense, has pores through which the sap is drawn into the branches and leaves of the tree, so that it is impossible to avoid the leakage of sound waves. The vibrations of the air pass through it when it is used as a diaphragm.

The results of Dr. Helmholtz's experiments on a violin are of great interest in relation to making a good transmitter (*Sensation of Tone*, p. 136). To sum up his experiments, the excellence of a violin depends solely upon the kind of wood, that is the density and regularity of the fibres, and the skill of the manufacturer. When the front or belly is very dense with very small uniform pores, it gives a very good note, because the sound waves generated from the string cannot get through the board, thus giving the wood corresponding vibrations. This is why a close-grained wood is used in the front board, while in the rear a porous board is used, in order to allow the vibrations of air contained in the violin to escape from its confined position.

We can see from this that certain woods, such as pine or the wood which is used in the front board of a violin, will give better results as a telephone diaphragm. The accompaning views (Fig. 3) show sections of two different kinds of wood seen through a microscope.

Thus for the first condition given above, the metal plate will give better results than the wooden plate, but the metal plate is heavier than the wood diaphragm. Another difficulty is that the metal diaphragm cannot respond to the small vibrations of sound waves. To compensate for this, it is important to make a small opening in the front plate holding the diaphragm, so that the whole enlarged sound wave which is pronounced before the transmitter is concentrated on one point of the diaphragm.

Distortion of the Field by the Armature.

BY F. H. SLEEPER.

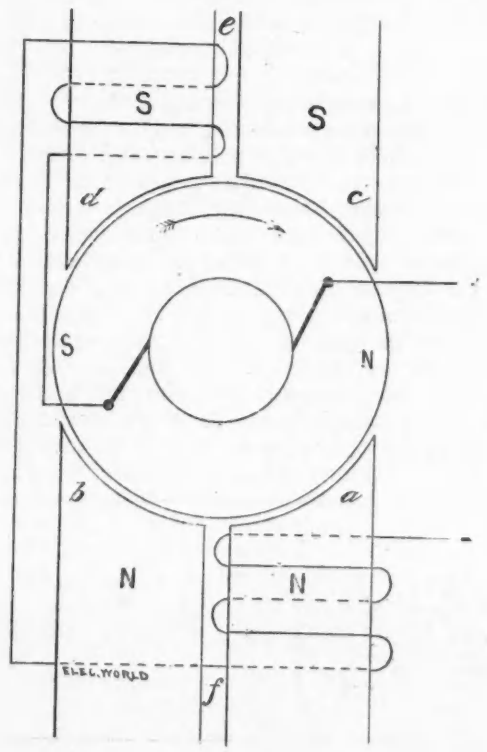
It is well known that when carrying current the armature of a dynamo or motor reacts upon the field, weakening it and generally making it necessary to shift the brushes in order to prevent sparking.

The cause of this distortion has been attributed by some to the dragging of the armature conductors as they revolve, but it has been shown in the columns of The Electrical World that if a stationary cage-like winding be placed about the armature and the main current caused to flow through it in the opposite direction to the current in the armature conductors, the reaction of the armature may be entirely neutralized, thereby showing that the reaction is not due to the course just mentioned.

When the armature is loaded it becomes a strong electromagnet, whose poles are at the points of brush-contacts in the gaps between the poles of the field, and are of the same polarity as the horns they are approaching.

Referring to the accompanying sketch the *N* pole of the armature, which lies partly under the horn *a* and is of the same polarity, weakens the magnetic pressure at *a*, thereby lessening the number of lines that will pass through the resistance of the air-gap at that point, while the opposite effect is produced at the horn *c*, thus the magnetic flux through the horns *a* and *d* is lessened, while that through *c* and *b* is increased. The field would be similarly distorted if the armature was fastened to prevent its rotating and current supplied from a separate source.

As a remedy for this distortion the writer suggests that the pole-pieces be divided by deep, narrow grooves *e*—*f* and that a proper number of turns of main circuit winding be placed upon those parts



METHOD OF NEUTRALIZING ARMATURE REACTION.

of the poles which form the leading horns in such manner that the magnetic pressure at those parts *a* and *d* shall be increased to such an extent as to neutralize the weakening effect of the approaching armature poles, and in addition to increase their power as much as the horns *c* and *b* have been increased by the receding armature poles.

This winding, if properly proportioned, will cause the sparkless points to remain stationary at all loads, and this point will be midway between the horns, which position is more efficient than a forward one. This can also be applied to motors, in which case the armature would have to revolve in the opposite direction, but as a compound-wound motor starts with too little torque it would be better to place half the winding on each half of the poles so as to strengthen the trailing horns and weaken the leading ones, which arrangement would permit of the motor being reversed, as the current on these windings would be reversed, they being in series with the armature.

The Siemens & Halske Electric Company of America.

One half hour's run from the Chicago business centre brings us to the town of Siemens, an industrial village growing up about the manufacturing concern known as the Siemens & Halske Electric Company of America. This company has met with unusual reverses since its incorporation, but it has stubbornly fought its way to the front and maintained its position and the price and quality of its machinery.

The works were formerly those of the Grant Locomotive Works and were purchased and occupied in a surprisingly short time after the fire which destroyed the former Siemens & Halske works. Fortunately the patterns and drawings were saved and the manufacture of the machines was not hindered. It is now at a point far in advance of its business position held before and at the time of the calamity and continued prosperity seems assured.

The Siemens & Halske dynamo may truly be said to have magnetic and electrical advantages far in advance of its competitors. The armature is outside the field, and thus being of large circumference accommodates a great many conductors. This means low speed. The field magnets, being internal, have a shorter magnetic circuit than any other type of machine, and the construction of the dynamo is such that an immense pole-shoe is permissible. This makes the magnetic reluctance so low that the necessary flux of lines is obtained with a very small magnetizing current which effects a material increase in the efficiency of the machine. This field magnet is shown in Fig. 1. A polygonal block of cast iron forms the nucleus. This is so cast that the depth of the gates is extreme and causes the magnetic part of the piece to be very uniform and homogeneous in its character.

The pole-shoes and magnet-waists are of soft steel and bolted to the planed facets of the nucleus. Flanges on the latter are provided for attaching the magnet to the engine bed. The machines are usually compound-wound, the winding shown in Fig. 1 being employed. Concentric rings of metal suitably insulated connect the series coils together.

In Fig. 2 is shown the field casting exhibiting the unusual depth of gate. The method of facing up the cast-iron nucleus is interesting. For small machines the casting is run through two large straddle mills mounted on a special machine for the purpose. This

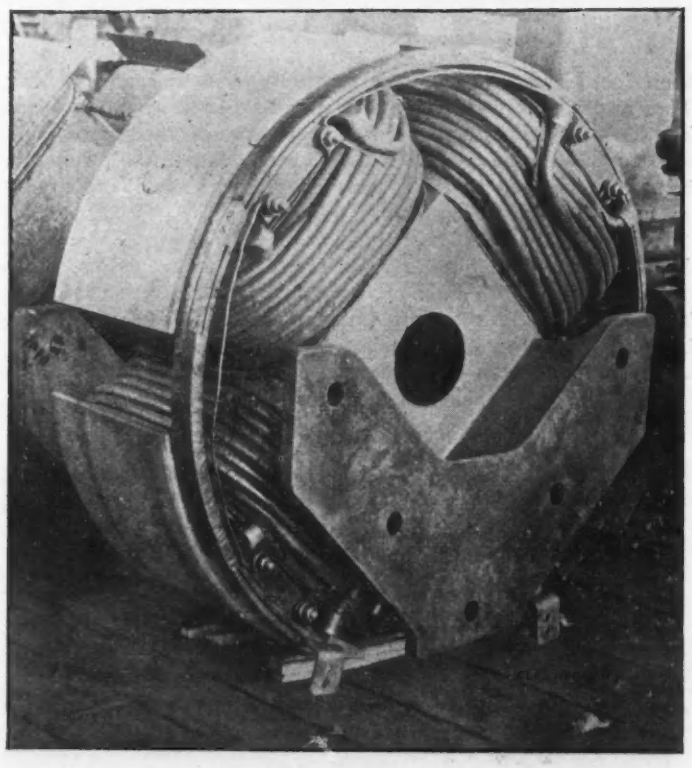


FIG. 1.—FIELD MAGNET.

rapidly and accurately finishes two sides at the same time. This machine is shown in Fig. 3, and an inspection of its construction will demonstrate its ability to do powerful and accurate work. Unfortunately the larger machines are too heavy to finish in this rapid manner. The labor of shifting such a heavy casting is too serious, therefore the method shown in Fig. 4 is adopted. A little portable planer is mounted upon the casting and it is arranged to swing about a central axis, thus planing the faces symmetrically with reference thereto. The planer is swung into as many angular positions as there are faces to be finished and is driven by a little electric motor mounted thereon. In this way the casting can be planed wherever it happens to be on the shop floor. The planer cuts on the up stroke. This is a rather curious feature and is exactly the opposite of what would be supposed, but practice has shown it to be best.

The winding of the field magnet is done in a lathe according

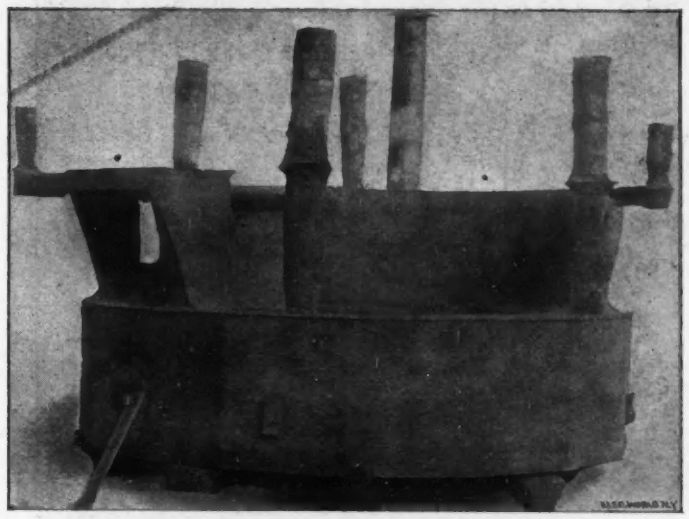


FIG. 2.—FIELD CASTING.

to the most improved practice and the best insulation is liberally used.

The armature is perhaps the most interesting feature of the machine, both mechanically and electrically. In Fig. 5 the method of assembling the core is shown. A many-armed star forms the basis of the mechanical structure. From each point of the star protrudes a steel bar, and on these bars the segments forming the core discs are threaded. These bars are electrically insulated from the segments by tubes of pressboard and mica, and magnetically from the star arms by heavy composition bushings. Were it not for the latter there would be considerable magnetic short-circuiting, as the star arms connect points on the armature of quite different magnetic potentials. The segments are placed on the star arms so that the joints are broken and the adjacent sectors are insulated from each other with paper or varnish. Between every two arms is a hole for ventilating purposes, and at equal distances from each other in the

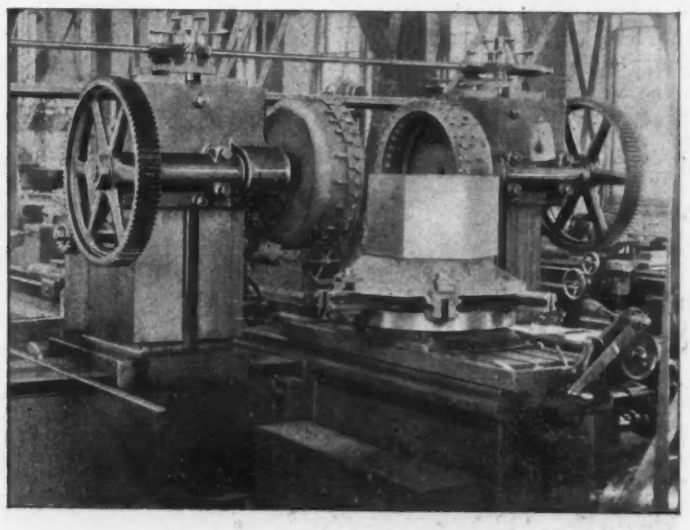


FIG. 3.—SPECIAL FACING MACHINE.

construction of the armature are ventilating spaces with which these ventilating holes communicate, and thus the surface cooled by the current of air is increased. The method of forcing the air in these holes is unique and different from that used on any existing machine. Driven tightly in each hole is a pipe of precisely the same shape as a clay tobacco pipe, except that the internal dimensions are

much larger. One set is turned in such a direction as to scoop the air as the armature rotates, and the other set which is on the star side is arranged to point outward, and the powerful draft caused by the centrifugal fan action of the arms draws the heated air out and thus maintains circulation within the core of the armature. This arrangement of pipes is shown in Fig. 6.

After the core is formed the segments are tightly set up against

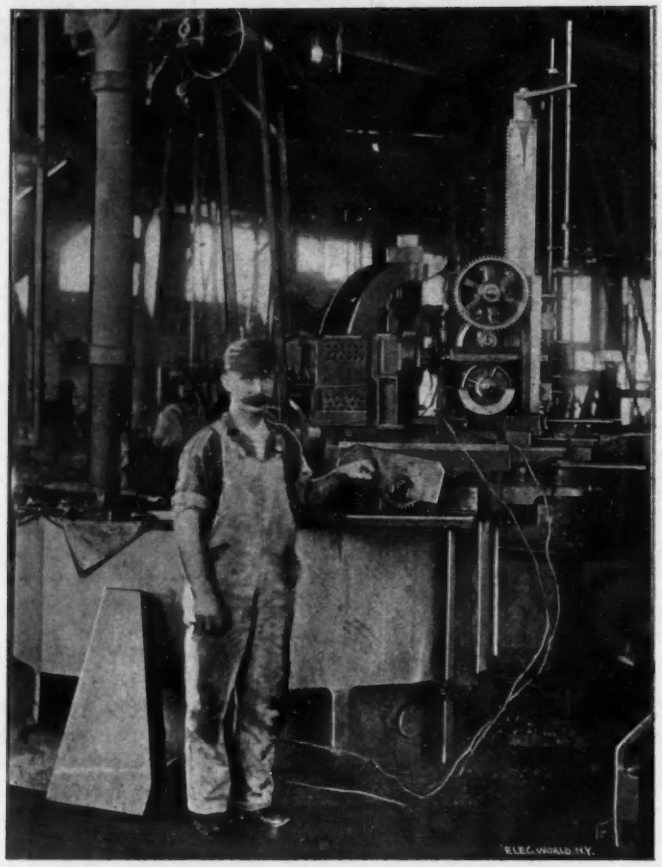


Fig. 4.—Machine for Facing Large Castings.

each other and it is then served with a coat of zinc white. This fills all cracks and crevices and gives a very smooth surface on which to build up the winding. Moreover, it reduces the chance of abraiding the insulation on the sharp edges.

The armature conductors consist of forgings of copper, one of the bars bent into a rectangular shape, being shown in Fig. 7. The short arms are hammered out flat, cleaned, tinned and slotted, and after being suitably taped they are ready to be put on the armature core. The conductor that delivers current to the brush is a piece of rolled copper with the ends slotted and tinned, and is insulated from its neighbor by a special combination of pressboard and mica. This

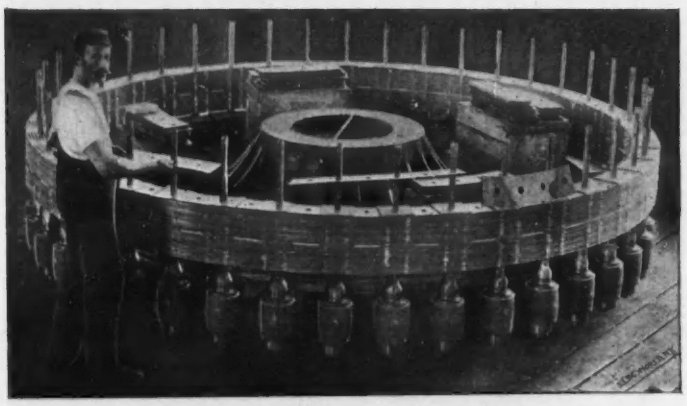


Fig. 5.—Assembling the Core.

bar connects the end of one of the ⌊⌋ shaped pieces with the end of that next adjacent as indicated in Fig. 7, thus forming the simplest of all windings, the Gramme ring. When it is necessary to surround a star bolt or similar projection, the group of conductors are specially shaped for the purpose, as shown in the extreme left of Fig. 7. The conductors are arranged about the insulated core and the ⌊⌋ shaped pieces are driven in the ends of the connecting bars which rests in insulating troughs. The insulation is all cut and ready, the bars and groups of conductors to surround star bolts are arranged and therefore the work of putting on the coils is rapidly accomplished. It only remains then to tighten and solder them. This process is quite interesting. First the conductor below and the bar above are driven down tightly and clamped by powerful U-shaped clamps. The protruding end of the flattened arm of the lower conductor is bent to one side for convenience in the next

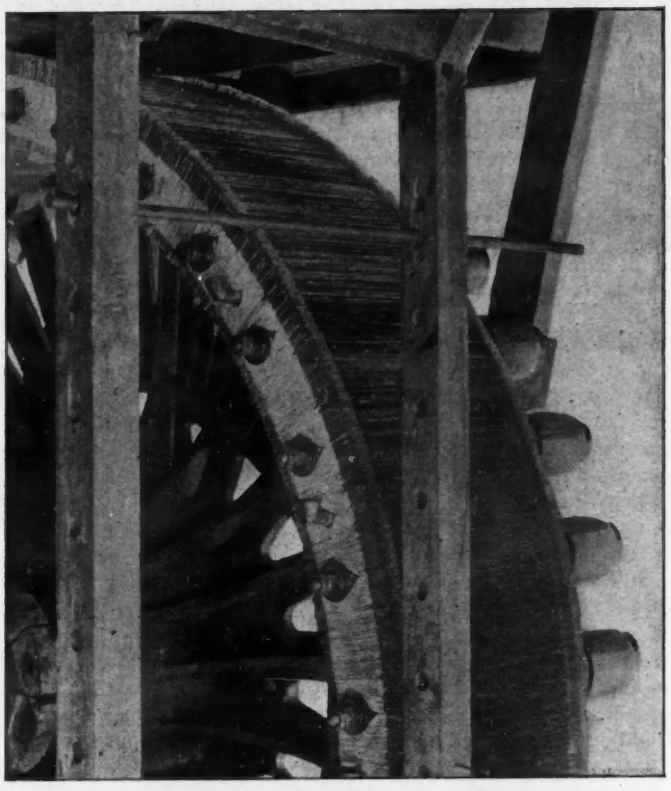


Fig. 6.—Arrangement of Ventilating Pipes.

operation. This is to grasp the protruding end by a special clamp. Then a split chisel is driven under it and raises it up tightly, drawing the ⌊⌋ about the core of the armature. The surplus end is then cut off and the joint is soldered with a large iron. This work is so systematized that it is accomplished with surprising rapidity and precision by only two men.

In winding the very large armatures it is necessary to erect scaffolding about them, for all the work must be performed at the top of the armature. Fig. 8 shows a view of the armature surrounded by its scaffold. It is supported upon powerful horses, so that it can be easily turned upon its axis as the work proceeds. After the armature is wound it is transferred to a large lathe and turned up true. The edges of the armature are then finished with plaster of paris and given a coat of black enamel. It is then smoothed, trued

Fig. 7.—Armature Windings.

up and shellacked. It is a very simple matter in case of trouble to remove or renew one of the coils of the winding without in any way disturbing any of its mates, or damaging the continuity of the winding, an important feature which may be safely said is possessed by few other armatures of equal current capacity. The machine that is

being assembled, as shown in Fig. 5, is one of 1600-kw capacity for railway service, and is perhaps the largest railway generator ever built in this country as a commercial size. This is the only company that builds armatures of this size complete in its factory. Other makers find it necessary to assemble their armatures in the plant where they are to be used. It is, of course, a great advantage to have this

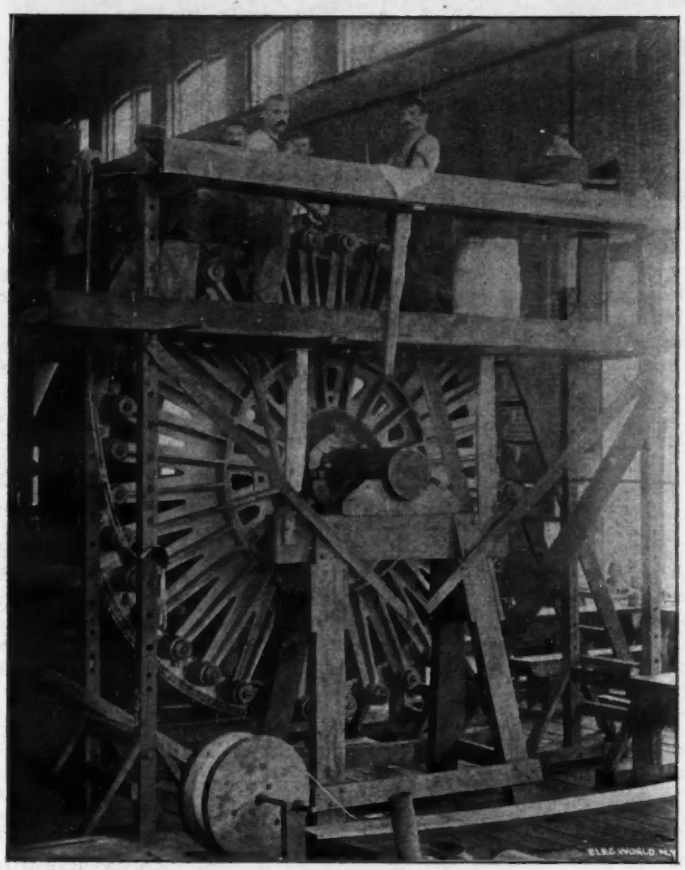


FIG. 8.—WINDING A LARGE ARMATURE.

work done where it can be constantly under the eye of the superintendent.

The regular form of brush holder for the Siemens & Halske dynamo is a star of the same number of arms as there are pole-pieces, on each of which is mounted a set of bushes. It is more or less familiar to every electrical engineer. On the large machines it is found that this star construction is not sufficiently rigid to give

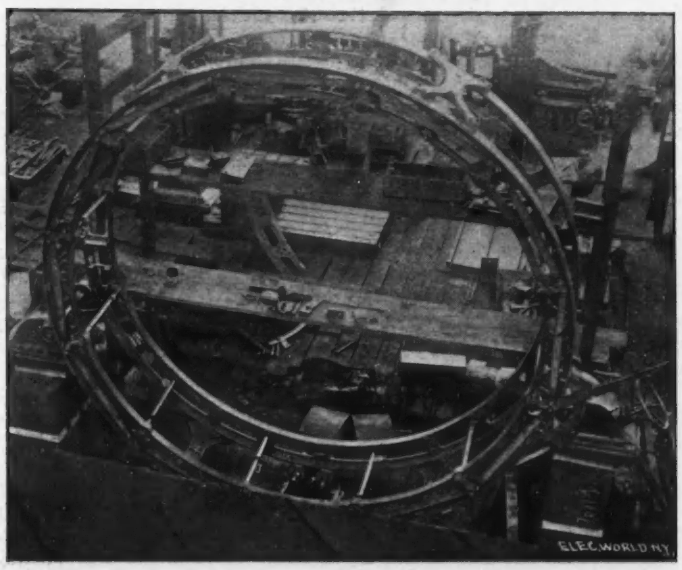


FIG. 9.—CAST IRON RING.

satisfaction, and therefore a new form which is quite interesting has been designed. It consists of a large skeleton arrangement of cast-iron rings connected by X-shaped stays. Although this ring entirely surrounds the massive armature just referred to and is of great height (Fig. 9), yet the amount of distortion due to its weight is less than one-sixteenth of an inch, and when properly supported, as it will be in practice, it will be negligible. Threading through the supporting rings and pivoted in each of them is a series of bars equal in number to the number of pole-pieces, which is 12 for a 750-kw machine.

Levers are arranged so that all the brushes may be let down by the commutator simultaneously, and a suitable screw adjustment varies the angular position of the ring with reference to the commutator, so that the brushes come on the neutral lines. This construction is an innovation in Siemens & Halske machines, and its operation in practice will be watched with much interest. The machine, if it be direct-connected, is assembled on special bearings and tested.

The testing room is the subject of Fig. 10. It is provided with a large motor, by which all the machines are driven. Thus the input of every machine tested can be accurately measured, since the efficiency of the large motor is known. The output is readily measured by means of a voltmeter and ammeter in the circuit, which returns the current to the line, and a very accurate idea of the efficiency of every single machine that leaves the works can be thereby obtained. This is seldom practiced by any large manufacturers of dynamos, the operation being simply to run the machine, ascertain that it does not heat excessively at any part, test its insulation, and give it, in brief, a test of durability rather than one of efficiency. Of course, the Siemens & Halske machines are given the durability test, but in addition they also get the efficiency test, which is of great value. The low speed of the machines is surprising and is not really appreciated until actual figures are known. The little machine shown in the cut has a capacity of but 25 kilowatts and yet its speed is below 400 revolutions. It is an admitted fact that the larger the number of commutator bars the better will be the electrical action of the machine. In this point the Siemens & Halske dynamo has reached the limit. It could not be feasible to subdivide the winding of the armature further, as this construction provides one commutator bar for each turn of the coil.

(To be continued.)

The Watson Telephone Switch Patent Declared Expired.

A despatch from Chicago states that Judge Showalter, in the United States Circuit Court on Nov. 7 issued an order of great importance to telephone interests.

The Western Telephone Construction Company it is stated, was the principal defendant in the suit which was brought by the Bell Telephone Company and the Western Electric Company. The Western Telephone Construction Company recently discovered that a Canadian patent had been issued on the Watson telephone switch on July 30, 1880, which had the effect of shortening the life of the American patent on the same invention, and on this fact the order of the Court was made. The American patent, the Court states, expired on July 30, 1895.

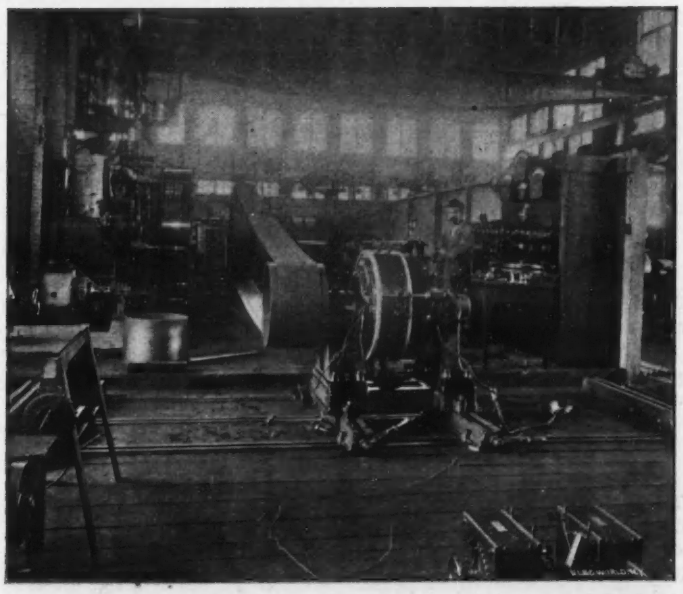


FIG. 10.—TESTING ROOM.

The court has had the case in which the Western Electric Company charged infringement under advisement since last Summer and in the mean time the Western Telephone Construction Company discovered this new evidence. Aside from ordering the admission of this testimony Judge Showalter could do nothing further until he renders his decision.

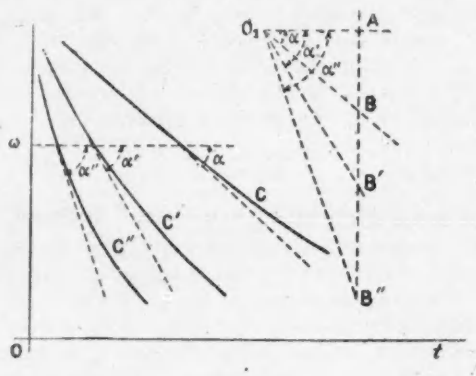
DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

New Method of Determining the Efficiency of a Dynamo. ROUTIN. *L'Eclairage Elec.*, Oct. 24.—A brief description of a new and apparently very simple method. The efficiency can be readily calculated, knowing the number of watts delivered, the number of watts used per excitation, those lost in the armature, and the number of watts corresponding to the combined losses by hysteresis, Foucault currents, friction and air resistance; of these all but the last group are easily determined; the present method is for measuring this last group of losses, thus enabling the efficiency to be calculated. The machine is run at a speed slightly higher than the normal by starting it as a motor; the current is then stopped suddenly and the armature allowed to run with its own momentum; the power whose value it is desired to determine is the one acting to bring the armature to rest; with the aid of a tachometer the speed is then read at short intervals of time, say every 10 seconds, and the results plotted in the form of a curve C in the adjoining figure, in which the abscissas are



time and the ordinates *speed*, the horizontal dotted line representing the normal speed. He gives the mathematical expression for the forces which tend to bring the armature to rest and to eliminate the value of the mass and the radius of gyration; a second test is made in the same way, but with the addition of a small brake applied to the pulley, the power absorbed by it being measured; the curve C' represents the results under these conditions. Draw tangents to these curves at the points where they intersect the line representing the normal speed; then the value of the power to overcome the mechanical losses is calculated from the following formula (presumably in kgm. meters per second):

$$p = \int \frac{\tan \alpha}{\tan \alpha' - \tan \alpha_1}.$$

in this formula f represents the power absorbed by the brake for that speed. By drawing the diagram to the right of the curves in which the angles are those above referred to, the formula reduces to

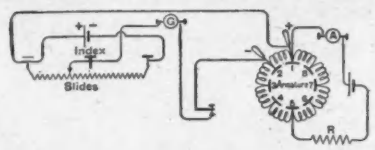
$$p = \int \frac{AB}{BB'}.$$

For determining the power corresponding to the hysteresis and Foucault current losses, a similar test is made while the machine is excited to its proper amount; the curve C'' represents the results of this test; the power absorbed is then given by the following formula in which p is the value of the mechanical losses mentioned above;

$$q = p \frac{BB''}{AB}.$$

To illustrate the application he gives the results for a 220-hp three-phase alternator and for a 23-hp continuous-current machine. The method is equally applicable to large as to small machines, and for the former it has the great advantage of requiring only about 2 per cent. of the normal power of the machine; it requires no other instrument than a good tachometer which can be very accurately standardized and can be read with great precision; the method can also be used to find the variation of the losses by hysteresis and Foucault currents as a function of the induction; also for studying the law of the variation of the air resistance or the lubrication of the bearings.

Detecting Faults in Armatures. TINSLEY. Lond. *Elec.*, Oct. 23.—A description of a comparatively simple, practical method of detecting faults between the windings, as distinguished from those between the winding, and the core. The arrangement is shown in the accompanying figures the left hand side of which shows a sensitive potentiometer, which is joined up as usual for testing potentials, the two ends to be connected to the coils terminating in metal spikes with insulated handles. A current from an accumulator is passed through the armature, as shown, between two diametrically opposite points, the strength of the current being kept constant and being sufficiently high to give suitable deflection on the instruments, a few amperes being usually sufficient; the potentials are then measured at the terminals of each of the successive coils, and when these differ considerably it shows cross-contacts between



the windings, or when they are zero shows that the coil is short-circuited. A table of the results of a test is given, showing some short-circuited coils and some that have several turns out, while another has one turn too many. The method is said to be an excellent one, being quick and accurate, while it is better than a resistance test; the voltages on the coils in the two halves may not be alike owing to the current being different in these two halves.

Three-Phase Motors. BRESLAUER. *Elek. Anz.*, Oct. 25.—The beginning of a reprint of a lecture giving a simple explanation of the action of such motors.

LIGHTS AND LIGHTING.

Car Lighting by Electricity. MOSKOWITZ system. *Eng. News*, Oct. 29.—A well-illustrated description of this system which has been tried experimentally for some years and is now in use on some railway cars. Each car is independent of the others and of the engine. The system comprises a dynamo driven from the car axles, a storage battery and a switchboard; it is entirely automatic, requiring no special attendant; a dynamo weighing 300 pounds is attached to the truck frame beneath the car and is self-regulating for varying rates of speed, which is accomplished by a new method of winding not described; no current is generated below a train speed of eight miles an hour; a switch changes the poles automatically when the direction of motion of the train is changed. There are two sets of batteries under the car, one of which is furnishing the light while the other is being charged; when the former is exhausted a switch is automatically turned, throwing the charging battery into service and connecting the other to the dynamo. If the batteries are first charged sufficiently to furnish light for six hours, the plant will furnish light for 10 to 15 hours every night if the car is kept running; the two sets of batteries contain 32 cells each and weigh together 1440 pounds. A car with this system is running between New York and Philadelphia.

POWER AND HEAT.

Turbo-Electric Generator for Alkali Works. Lond. *Engineering*, Oct. 16.—A well-illustrated description of a large 410-kw direct-coupled dynamo and Parsons's steam turbine, the dynamo, which is double, being connected with the two armatures in parallel, having an output of 3416 amperes at 120 volts; the turbines are designed for an expansion ratio of two hundred-fold and are guaranteed by the makers to consume only 15 pounds of superheated steam per electrical hp-hour; the speed is 3000 revolutions.

Transfer Table. *L'Elec.*, Oct. 24.—A brief, illustrated description of the electrically operated transfer table for railway cars in a new railway station in Madrid.

Gas vs. Electricity for Power Transmission. PERRY. *Eng. Mag.*, November.—He shows that power can be transmitted more economically in the form of gas than in the form of electricity, although it is much more available in the latter form, and he therefore recommends transmitting the energy in the form of gas over the larger distances and then generating electricity with gas engines and distributing the electrical energy over short distances, far shorter than now generally used; he recommends gas storage at the outlying centres and shows that the cost of gas storage is much less than the storage of energy in electrical accumulators; he admits, however, that the storage battery might be used to good advantage in such a plant so as to keep the gas engines and dynamos at the outlying centres operating constantly under the best conditions. He differs with the views expressed by Dr. Duncan in his recent address and advocates

increasing the radius of transmission and decreasing the radius of distribution, instead of increasing the latter, as recommended by Duncan. He shows that gas engines of large size do not necessarily have a lower efficiency and that the efficiency at light loads compares very favorably with that of steam engines under similar conditions; he discusses briefly the subject of power-gas, which, though cheaper to produce, is more expensive to transmit on account of its lower fuel value.

Use of Electric Power in Small Units. ELMER. *Eng. Mag.*, November.—He believes that the most promising fields for the electric motor is where it may be used in small units, as in mills and factories, and after enumerating the well-known advantages of electric motors in such places he describes some plants of that kind and sketches out what he considers an ideal scheme which could be applied to mills and factories as at present arranged, in which he recommends two-phase alternating currents of 220 volts. In a great many cases the direct-connected individual motor is best, but at the present time it would be bad practice on account of the large amount of capital required.

Power Plant at Lake Biwa-Kiota, Japan. TANABE. *Sc. Am.*, Nov. 7.—An illustrated description of the canal in connection with this lake, including a brief description of the water-power station for the electrical distribution of power. The head is 105 feet and there are to be 20 Pelton water wheels of 120 horse-power each ; at present about 1000 horse-power is being sent out in electric power ; it appears that the continuous current is used ; the description is very, very brief.

TRACTION.

Electric Vehicle. L'Ind. Elec., Oct. 25.—A brief description of the Jeantaud carriage. The distinguishing feature is that the front wheels are used both for driving and for steering, the motor being secured to them; the advantage claimed is that there is then no longer the same fear of slipping; by means of a new device not described, the breaking of the current at the controller is done without any sparking, and the apparatus is very light; Fulmen accumulators are used having a capacity of 30 amperes per kg of plates; they can be discharged even at short circuit without injury; it will carry four persons besides the driver and weighs when ready for use 1000 kilowatts; with one charge 100 kilograms can be traversed on a level and 60 on the usual roads; the construction is made of steel, nickel and aluminum and the wheels are provided with pneumatic tires.

Surface-Contact System in Paris. L'Eclairage Elec., Oct. 24.—An announcement that Westinghouse electromagnetic system is to be tried experimentally on a grade in the City of Paris for a distance of 500 metres, and if successful it is to be used on a number of lines in that city.

Shunt Motors for Railway Work. Elec. Eng., Nov. 4.—A note stating that on some hilly lines in Europe the Siemens & Halske Company have used shunt motors, contrary to the usual practice, the principal advantage claimed being that current may be returned to the line on the down grades; a diagram shows how much current is theoretically recovered on the down trip. Among the other advantages are the fact that the brake-shoes do not wear out nearly as fast, the loss of voltage in the feeders is materially decreased and as the cross-section of the feeders may be diminished the investment in the line is decreased, as also the size of the power-house.

Derail for Electric Railway. GIBB'S system. *Eng. News*, Nov. 5; an illustrated description.—The object of the device is to guard against accidents at grade crossings; the present system is said to be in extended use along the lines of a railway from Chicago to St. Paul. The characteristic features are that the motive power of the electric cars is cut off when it is necessary to block the line, and a derailing device is provided to prevent the cars from drifting over the crossing; the latter device is the one described.

Street Railways. Eng. News, Oct. 29.—A number of the papers read at the recent St. Louis meeting of the Street Railway Association are reprinted in this journal.

Submarine Boat. Elec. Eng., Nov. 4.—A brief, illustrated description of the "Lake" boat, which is being constructed in Baltimore. Besides having a propeller it is mounted on wheels for traveling on the bottom; it is intended partially to be used as a wrecking boat and is provided with a crane. It contains a compound steam engine of 70 horse-power, a motor (presumably electric) of 10 horse-power for driving the wheels and a generator which can also be used for driving the propeller; the designer found that direct driving on wheels was more economical than by means of a screw; there are 60 accumulators; the estimated speed when running on the surface is about 8 miles and when submerged about 5 miles; the air supply is sufficient for six men for 48 hours, the air being compressed in a tank at about 70 atmospheres; when submerged, one charge of the battery is intended to suffice for 60 miles; the displacement is about 100 tons.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central Stations in Paris. L'Ind. Elec., Oct. 25.—A large and apparently complete table of information regarding each of the seven central stations in the City of Paris, one of which is a municipal station; it is accompanied by a brief description of the recent additions. All the stations are increasing rapidly in their capacities. A double page map is given showing the territories covered by the various stations or sectors, as they are called, owing to the general shape of the territory. In conclusion a general summary is given. The total consumption of energy in the year 1895 was 8,107,253 kw-hours, while in 1894 it was 7,883,434; in October, 1896, the total power of the machines was 17,775 and of the accumulators 1610; the number of arc lamps was 7448, the number of incandescents 417,468; there were connected 293 motors of 858 kilowatts; 220 of 574 kilowatts are in use for elevators; the total power of motors installed is 1432; 6 kilowatts represent the total power installed for heating; the ratio of the total power installed at the consumers, to that at the station is 1.309; in 1895 the mean charge was 23 cents. A curious fact is that during the past year a number of consumers abandoned the electric light in favor of the Welsbach, but after a time they again returned to the electric light, even at a higher price.

Central-Station Statistics. RITTERSHOUSEN. *Elek. Zeit.*, Oct. 22.—A criticism of some of the statements in the article by Ross noticed in the *Digest*, Oct. 3 (see also Oct. 17). Some of the results tended to show that the "yearly burning time" (the ratio of the useful output during the year and the maximum output for one hour) of some of the stations is increased very materially when the station also furnishes current for electric railways. He discusses this point and shows that the only advantages in combining light and power stations is in the saving of the managing costs, salaries and wages, which form only a small portion of the total; the advantages of furnishing current for railways can therefore not be great. He believes that there would be a gain, however, if the current were used for electrochemical industries.

Bradford. Lond. *Elec.*, Oct. 23.—An editorial notice that this station has decided to supply consumers with lamps free of cost in order to protect the consumers against the sellers of cheap and poor 200-volt lamps; the testing of the lamps will probably accompany this change; the station will also rent small motors from 0.5 to 6; what is still wanting is municipal free wiring.

Rouen. L'Energie Elec., Oct. 1.—A brief, illustrated description of this station in France, the article forming the first of a series on such stations.

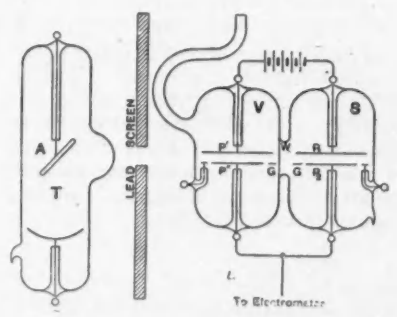
Geneva. BLONDIN. *L'Eclairage Elec.*, Oct. 24.—The beginning of a series of descriptive illustrated, articles of a number of stations visited by the recent electrical congress in Geneva; in the present portion some of the stations in Geneva are described.

Central-Station Insurance. Lond. *Elec. Rev.*, Oct. 23.—The views of an insurance officer on the insurance of central stations.

Saint Elizabeth Hospital. Elec. Eng., Nov. 4.—A description of the St. Elizabeth United States hospital for the insane, near Washington, D. C., including a description of the electric lighting plant which has recently been installed and has a capacity of 6000 lights; a continuous-current three-wire system is used.

ELECTRO-PHYSICS AND MAGNETISM.

New Vacuum Gauge for Röntgen-Ray Tubes. BARR AND PHILLIPS. Lond. *Elec.*, Oct. 23.—An illustrated description of a gauge which will give readable indications of the pressure in high vacua ; it is based on the recent investigation of Perrin. The description accompanied by the illustration is as follows : "Two glass vessels, *V* and *S*, as shown in the figure, are joined by a common wall or window, *W*, and contain respectively two small condensers, P' P'' and P_1 P_2 arranged so that they lie close together with their plates in the same plane. The upper



plates, P' and P_1, are joined to the two terminals of a battery or other source of practically constant E. M. F., so that the lower plates, P'' and P_2 are oppositely charged. These latter (P'' and P_2) are connected together and to the needle of an electrometer, which remains at zero. If now a beam of X-rays passes through both condensers, and if the total rate of discharge (algebraic sum) is naught, the electrometer needle will still give no indication. Now the vessel *S* contains dry air (at, say, 30 in. barometer) and is sealed off ; but the vessel *V* is connected with the air pump. Hence, as the air expands more and more out of the chamber *V*, the number of ions which can be dissociated per second (by a beam of X-rays from a tube, *T*, crossing the tubes of force in the condenser) grows less and less. Hence the needle of the electrometer begins to

deflect and the scale readings increase as the exhaustion of the vessel *V* proceeds. These readings form the criterion as to the degree of exhaustion."

Röntgen Rays. Muller. *L'Eclairage Elec.*, Oct. 24; abstracted from *Wied. Ann.* 58, page 771.—He described some phenomena which he observed and which can be attributed either to the deviation of the rays by a cylinder of brass or to their diffusion in the air, and he thinks the latter interpretation is by far the more probable. His observations tend to prove that a portion of the rays are diffused around the objects. Regarding the hypothesis that X-rays have very short periods of vibration he states that this is not compatible with the transparency of air for these rays, as rays having extremely short wave-lengths can traverse only very thin layers of air.

Cathode Rays. Poincaré. *L'Ind. Elec.*, Oct. 25; an abstract of an Academy paper.—He refers to some recent observations by Birkeland, who found that by placing a Crookes tube between very powerful magnets certain attractions and repulsions were exercised by the magnetic poles on the cathode rays; what appears paradoxical is that the phenomena does not change when the poles of the magnet are reversed. In the present paper he shows how this can be explained without introducing any new hypothesis.

Photometric Sensitization of Salts by Cathode Rays. Elster and Goldstein. Lond. *Engineering*, Oct. 23; a brief abstract of a B. A. paper.—Goldstein observed that the colorless alkali chlorides become colored by cathode rays; cathode tubes become slowly covered with a brownish film which seemed to be metallic potassium or sodium. Salts were placed in the tube under the influence of cathode rays; also outside of the tube; it appears that cathode rays falling on the chlorides of alkalies convert them into bodies which cannot keep a negative charge in visible light; it is thought that the metals deposited do not remain on the surface, but pass into the interior.

Effect of the Moon's Rays on Photographic Plates. Dormann. *Elek. Anz.*, Oct. 8.—An abstract of a short article, in which he states that he exposed dry plates in an enclosed holder to the sun's rays and obtained no effect, but when exposed to the rays of the moon during a night they were completely blackened; pieces of metal produced no shadows, showing that they did not absorb these rays, which therefore traverse materials opaque to X-rays; masonry was the only material found which was opaque to them; when the moon was near the horizon shadows similar to those produced by X-rays were obtained; black materials near the plate, especially when they touch it, produce stronger light effects; in some cases the structure of the wooden case was shown on the plate; the rays seemed to pass more readily through the densest bodies; it is suggested that the rate of oscillations of these rays is still greater than that of the X-rays. (The article seems to have just appeared in a non-technical paper.)

Electricity of Contact. Wesendonck. *L'Eclairage Elec.*, Oct. 24; abstracted from *Wied. Ann.* 58, page 411.—Christiansen recently expressed the opinion based on experiments that the difference of potential between mercury and amalgams can be attributed to the action of oxygen; the present writer believes that the above experiments can be given a different interpretation.

The Discharge of a Single Nerve Cell. Gotch and Burch. Lond. *Elec. Rev.*, Oct. 23.—An abstract of a B. A. paper discussing the electrical organs of the "malapterurus electricus," and contrasting it with that of the "torpedo."

Electric Properties of Vapors from Electrified Liquids. Schwalbe. *L'Eclairage Elec.*, Oct. 24; abstracted from *Wied. Ann.* 58, page 500.—He discusses the electric properties of vapors from an electrified liquid.

Comparison and Reduction of Magnetic Observations. Lond. *Elec.* and *Elec. Eng*, Oct. 23.—A reprint of a report of a B. A. committee by its secretary, Prof. Chree, concerning the results of the measurements of the earth's magnetism at the Kew Observatory. It is mainly devoted to what he calls the non-cyclic effect or variation of the horizontal force, it being equal to the difference between the mean values of the horizontal force at the first and second midnights of a selected series of days. It is followed by an appendix by Ellis.

Fluorescent Screen for Röntgen Rays. Buttemer. *Sc. Am.*, Oct. 31.—He gives the following brief instructions for making such screens. A piece of black cardboard is brushed over with gum and the salt sifted over it; calcium tungstate gives a foggy image, as it phosphoresces as well as fluoresces. Another method is to mix the powdered salt with flexible collodion containing a percentage of castor oil, and coating the card or aluminum film with it; or the card may be coated with dilute flexible collodion and the salt sifted over it. In all cases success depends on finely powdering and sifting the salt, drying it carefully if necessary; he uses "120 to the inch" (presumably referring to the meshes of the sieve).

Nature of Röntgen Rays. J. J. Thomson. *Am. Jour. of Sc.*, November.—A reprint of a large portion of his recent address (see *Digest*, Oct. 3).

Discharge of an Electrified Body by Means of the Tesla Spark. Smith. *Nature*, July 30, noticed in the *Am. Jour. of Sc.*, November.—He found that a high-frequency spark between two blunt points one inch apart in air acts like the Röntgen rays in dispelling electric charges of either sign.

Modern Views of Electricity. Dommerque. *El'ty*, Nov. 4.—An abstract of a paper read before the Chicago Electrical Association; it is devoted mainly to a review of the results accomplished by Hertz.

Induction Coefficients of Hard Steel Magnets. Peirce. *Am. Jour. of Sc.*, November.—He describes the preparation of a large number of deflecting magnets for the use of students in measuring by the Gauss method, the intensity of the earth's magnetism; he describes a method for determining the induction coefficients of such magnets, giving the results in a series of seven tables, mentioning the kind of steel used.

ELECTRO-CHEMISTRY AND BATTERIES.

Applied Electro-Chemistry. Lond. *Elec.*, Oct. 23.—An editorial on the recent lectures of Swinburne which are thought in some respects to be disappointing. It contains little of general interest except a statement that there are proposals to treat the poor iron ores of the Jura in the electric furnace so as to produce calcium carbide from the quick lime and carbon used as a flux, while the iron in the ore forms an alloy with aluminum or with manganese, as may be desired.

Progress in Electro-Chemistry in 1895. *Elek. Anz.*, Oct. 18.—The first part of an article giving a review of the progress; the present portion refers to metalloids.

Acetylene as an Electrolyte. Bredig and Usoff. Lond. *Elec.*, Oct. 23.—A translation in abstract of the article noticed in the *Digest*, Oct. 17.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Insulation Resistance of Wiring with the Line Voltage. May. *Elek. Zeit.*, Oct. 22.—The German Union having demanded that the installations be tested with the working voltage, he describes a simple method for doing this. For measuring the earth resistance or insulation in direct-current circuits up to 250 volts, a high-resistance voltmeter or milliampere-meter with a resistance in series, is used; in the present illustration he uses a milliampere-meter of one ohm resistance which can be shunted to measure currents or with resistances in series for measuring voltages. To measure the insulation resistance of a branch circuit, the circuit is first disconnected at the fuses and the milliampere-meter inserted in place by one of the fuses while the other terminal of the live circuit is connected to ground through a lamp, leaving the other terminal of the branch circuit connected with nothing; one or more of the lamps or motors on the branch circuit is then connected between these branch wires; a resistance of 1000 ohms is placed in series with the instrument; the current on the milliampere-meter is then read off and divided by 110,000 (the voltage being 110), the result, after subtracting the resistance in series with the instrument, being then the insulation resistance of the whole branch. Great care must be taken to insert a resistance of a few hundred ohms between the live wire and the earth, as for instance a lamp, as the other pole may be grounded; for more accurate measurement a milliampere-meter reading to 0.1 milliampere may be used; the insulation resistance of that pole of the live wire to which the instrument is connected has no effect on the measurement and it is therefore immaterial whether it is grounded or not. A table is given of the allowable leakage currents for branches with various numbers of lamps, being based on the rules and regulations adopted in Germany.

Measuring the Insulation Resistance of Circuits. Muellendorff. *Elek. Zeit.*, Oct. 22.—He refers to circuits such as those of three and five-wire lighting systems, and to the total insulation resistance, measured while the circuits are alive. In a simple two-wire system this is done by measuring the voltage between the two wires and between each one and the earth, calculating the insulation resistance from the readings; in the present article he shows mathematically that these three measurements are also sufficient for circuits having any number of wires, such as the three and five-wire systems; in all such systems it is therefore sufficient to make only three measurements, namely, the voltage between the two outside wires and that between each one of these and the earth. It also follows from his equations that the insulation resistance of each of the individual leads can be determined by this method; it is only with the two-wire system that these measurements enable the individual insulation resistance of the leads to be determined. To measure the insulation resistance for individual wires of a multi-wire system, the only way to proceed is to vary the voltage, and as this can be done only to a small extent while the plant is in use, the results would not be sufficiently accurate; if it is possible to disconnect the system of wires during the time that the measurement is made, the individual resistances can be measured by making that of all the lines but the one to be measured, zero; it is assumed that the insulation resistance is independent of the variation in the voltage.

Novel Application of the Loop Test. Rymer-Jones. Lond. *Elec. Rev.*, Oct. 23.—A description of a method which was tried and found to give very approximate results during a recent repair of a faulty submarine cable which was picked up and which showed that the conductor was completely broken and earthed, in which case there was difficulty in accurately determining the position of the fault. The loop test was used, but instead of measuring the resistance of the copper conductor, the relative resistance of the sheathing wire on either side of the broken conduc-

tor was measured. It is essential that the cable is not in water when the test is applied; it is described as a rough expedient to meet a special emergency in the case of submarine repairs.

Breaking Down a Fault. Lond. *Elec.*, Oct. 23.—A description of a method to be used on high pressure alternating-circuits when a high resistance fault is to be broken down prior to its location and repair; it is applied when the faulty cable can be isolated for a few hours. The low tension secondary of a transformer is connected with low tension primaries of two or three transformers in parallel, the high tension secondaries of which are connected in series, thus developing two or three times the voltage of the high tension current from the alternator; this high tension current is then passed through the cable, the fault and the sheathing, the alternator being started gradually, or if the current from the circuits is used, it is started through an adjustable resistance; care must be taken to fuse the transformers properly. It is sometimes necessary to repeat the process several times before the fault breaks down; the fuses often melt before the arc at the fault causes it to completely burn the insulation; it is necessary to be absolutely sure that the fault is in the cable itself and is not a surface leakage at the end; when three transformers are used in series, it is absolutely necessary to insulate the one connected to the conductor of the cable.

Eliminating the Vibration of Instruments. JULIUS method. Lond. *Elec. Rev.*, Oct. 23.—An illustrated description of an improved application of a method described by him last year. The chief features are that the instrument is placed on a frame which is suspended from three wires, the principle of which is that a special point, such as the point of suspension of the deflecting system, which to be protected from the influence of vibrations, should be as near as possible to the centre of gravity of the whole supported mass; the description is taken from *Zeit. f. Instrumentenkunde*, September. The suspending frame consists of three vertical rods suitably connected horizontally to circular rings so as to make a framework; this is suspended on three wires secured near the middle points of the rods; the instrument is placed on this frame and weights adjusted vertically on the rods so as to bring the centre of gravity to the desired point, which may be done by suspending the whole system on only one wire and moving the weights so that the frame is in a horizontal position, the vertical position of the instrument having first been adjusted so that the point of suspension of the needle lies in the plane of the suspension points.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Automatic Curb Transmission. Lond. *Elec.*, Oct. 23.—An illustrated description with details of the apparatus of the Muirhead system, taken from a book on the subject intended for the staff of the companies. The object of the curb system is to diminish the retardation; two currents are used, the object of the reverse or curbing current being to check the prolonged discharge and to quicken the return of the arrival curve; this curbing reduces the size of the signals. The message is punched on a slip of paper in right and left holes corresponding to the dash and dot, and the operation of reversal of currents takes place during the passage of every space in the paper; the machinery causes cams to make certain electrical contacts, the action of which is governed by the motion of these cams, which make one complete revolution for every space in the paper. Specimens of the signals are given.

Fast-Speed Submarine Cables. Lond. *Elec. Rev.*, Oct. 23.—A brief editorial reference to the recent suggestions of Mr. Preece, in which it is shown that he is theoretically in conflict with high authorities and that if he is practically correct he will have arrived at a correct conclusion from incorrect premises.

Double-Wire Telephone Switchboard. PIERARD. *L'Elec.*, Oct. 17.—A brief, illustrated description of a system which he claims is less complicated than others and does not give rise to confusion.

Fiftieth Anniversary of the Telegraph in Belgium. *L'Elec.*, Oct. 17.—A short address by Banneux, chief engineer of the Belgium telegraph department, on the occasion of the opening of the fiftieth anniversary. A translation appears in the Lond. *Elec.*, Oct. 23.

MISCELLANEOUS.

Production of Calcium Carbide by Steam Power. TENNER. *Zeit. f. Beleucht.*, Oct. 20; an extract from an article in a German paper.—He states that the present production of this material is far less than the demand, and he therefore estimates the cost of a plant and its operation by which this material may be made by steam, in Germany, where water-powers are scarce, where there are localities in which there is a large quantity of cheap and inferior coal, and where lime is plentiful. The complete estimate is reprinted and is given in detail; it is for a plant of 2200 horse-power, having a daily output of 7360 kilograms of carbide. The total cost of the plant is $231,000, to which must be added $14,000 for the ground and buildings, and a working capital of $62,000. The total cost of operation he finds is $128,500; a yearly production of 2291 tons (metric) at $75 per ton leaves a profit of $43,600.

Electricity in Naval Life. FISKE. *Elec. Eng.*, Nov. 4.—In this continuation of his serial he describes the engine telegraph, accompanying the same with good illustrations. This instrument is for signalling to the engine rooms the desired speed and direction in which to run the engines. The principle is similar to that of the other instruments described, in that it is based on a Wheatstone bridge arrangement in which contacts are moved over a resistance wire, the receiver being a galvanometer.

The Effect of the Election on Electrical Industries.

The burden that has laid heavily on business enterprise for the past few months as a result of the agitation in politics over the financial policy of the next Administration, has been lifted, and with its removal a decidedly hopeful feeling among business men is manifest.

In order to ascertain the views of the electrical and kindred trades regarding the effect of the election on the future business prospects THE ELECTRICAL WORLD solicited an expression of opinion from prominent individuals and companies engaged in these lines of trade, and the hope and confidence expressed in their replies cannot fail to have a stimulating effect upon the electrical business in general.

Judging from the replies received and here published there is every indication that the electrical business is entering upon an era of prosperity that it has not enjoyed for a long time.

A. SNOW, JR., New Bedford, Mass.—The natural result must be that business will gradually assume its normal state; the more gradual the healthier.

PRENTISS TOOL & SUPPLY COMPANY, New York.—We believe the effect of the recent election will be very beneficial to the general business interests of this country.

JOHN E. LOCKETT, 95 Milk Street, Boston.—It seems quite clear that business must soon improve. The electrical business must share in this general improvement.

CHARLES E. GREGORY, manager Elliptical Carbon Co., Chicago, Ill.—I firmly believe that an era of renewed activity in all branches of the electrical trades is at hand.

A. G. DAVIS, president Viaduct Manufacturing Company, Baltimore.—We feel sanguine of the future. Our business has already shown favorable effects of the election.

A. HOWARD ABENDROTH, treasurer Abendroth & Root Manufacturing Company, New York.—We have the utmost confidence in the revival of business within the next few weeks.

EUGENE MUNSELL & Co., New York.—We think all the conditions at present point to a very large business in the near future, which we believe will continue for a long period.

GEO. FRINK SPENCER, manager I. P. Frink, New York.—After election in every Presidential year business becomes more active, and this year we find the rebound most pronounced.

JOHN DICK, treasurer of the Phœnix Iron Works Company, Meadville, Pa.—There is already a very great feeling of relief, and we are unquestionably on the eve of prosperous times.

THE HORN & BRANNEN MANUFACTURING COMPANY, Philadelphia.—Business of all kinds, in our opinion, will revive, consequently there must be an increased trade in the electrical business.

H. J. MEDBURY, president Fiberite Company, Mechanicville, N. Y.—I believe that the election of McKinley will give a great impetus to the electrical business as well as all other kinds.

A. J. DOWLING, The Garvin Machine Company, New York.—I do not hesitate to say that with the settled conditions now assured, there will be an immediate increase of business in everybranch.

WARREN WEBSTER & Co., Camden, N. J.—Since election we have seen a great increase in the business, and we are filled with about as many contracts as we can handle with our present facilities.

FRANK BILLINGS, president Walker Company, Cleveland, O.—In my opinion the result of the recent election will have a beneficial effect upon all lines of business, and particularly upon the electrical business.

H. N. FENNER, president New England Butt Company, Providence, R. I.—We believe the settlement of the great question in favor of sound money will bring an era of prosperity to us all in every field of industry.

THE BALL ENGINE COMPANY, Erie, Pa.—We believe general business will improve, but not boom. Booms are not healthy. The electrical business will undoubtedly improve in sympathy with other lines of business.

C. H. DALE, president Peerless Rubber Manufacturing Company, 16 Warren Street, New York.—In our opinion the election means unprecedented prosperity for the next six or seven years in all lines of business.

BACKUS WATER MOTOR COMPANY, Newark, N. J.—The election, in our judgment, will, as it already has, improve business, and we trust it will continue to improve until matters are in satisfactory business shape once more

H. J. GORKE, secretary and treasurer Electric Engineering & Supply Company, Syracuse, N. Y.—We believe that business in general will revive, and that the electrical business will be one of the first that will feel the impulse.

JOHN P. COGHLIN, manager Columbia Electric Company, Worcester, Mass.—We feel very much encouraged by the prospects, and think that

business has materially changed for the better, due to the result of the recent election.

Elbert Wheeler, treasurer Wheeler Reflector Company, Boston, Mass.—We are sure that the election of McKinley and Hobart will lead to manifest improvement in business generally, and it is already apparent in our field.

J. T. Hambay, manager Beacon Lamp Company, New Brunswick, N. J.—We think the effect will be beneficial on account of restored confidence, and we cannot see how the result can fail to benefit the electrical business particularly.

J. C. Hobart, manager of the Triumph Electric Company, Cincinnati, O.—The writer is firmly convinced that as a result of the recent election there will be an unprecedented boom in the manufacturing industries of this country.

D. A. Andrews, Jr., vice-president and treasurer Pettingell-Andrews Company, 72 and 74 Federal Street, Boston.—I look for a return of confidence in all branches of business. The increase of business will probably be gradual and healthy.

E. H. Bennett, Jr., president Diehl Manufacturing Company, Elizabethport, N. J.—The election of McKinley has already given impetus to the electrical business, and I am further convinced it will result in a large increase of trade.

Chas. W. Farr, president Farr Telephone & Construction Supply Company.—The electrical business will feel the effects of the good times much quicker than other lines of business. It never looked so bright as at the present time.

P. Blaisdell & Co., Worcester, Mass.—Since the election the house received a large order for drills to be used in this country, and will likely soon run our factory on full time. Of late nearly all our machines have been going to foreign countries.

E. G. Bernard, president and treasurer E. G. Bernard Company, Troy, N. Y.—In our opinion business will increase; in fact, we already feel the effect of the election, and everything points to at least four years of prosperity to the manufacturer.

The New York & Ohio Company, Warren, O.—Our orders have already shown a marked increase since the election of Major McKinley, and we are confident of a satisfactory expansion of business with the return of confidence to the commercial world.

C. S. Mendell, president W. S. Hill Electric Company, New Bedford, Mass.—Business has been exceptionally good with us during the past three months. Personally I believe that the year 1897 will be the most prosperous that the country ever knew.

J. H. Mason, manager of the Simplex Electrical Company, Boston, Mass.—Were the good effects not already so apparent we could take time to discourse more fully on probabilities. As it is, we are busy with the present, and full of hope for the future.

Frank S. Minott, National India Rubber Company, Bristol, R. I.—The election of Mr. McKinley has already restored confidence in business and financial circles in Rhode Island. I feel certain that an era of prosperity has opened for the electrical trade.

W. C. Parsons, secretary The Replogle Governor Works, Akron, O.—Last Tuesday's victory cannot fail to result in an immediate restoration of large amounts of capital to the usual channels of trade. The return of confidence means activity and prosperity.

Campbell Scott, manager Louisville Electrical Works, Louisville, Ky.—In the electrical business I am convinced that we shall immediately see a considerable improvement, but it will not be nearly so great as in many other lines, at least for the present.

Herbert G. Pratt, treasurer Samson Cordage Works, 115 Congress Street, Boston, Mass.—There must be a very great increase in confidence which will doubtless materialize in the form of business as soon as people have time to gather themselves together again.

Chas. E. Bibber, of Bibber, White & Co., Boston, Mass.—We have already begun to feel the good effect of the recent Republican victory. It is my opinion that the election will have a good result on general business, and particularly in the electrical business.

M. E. Hershey, general manager Harrisburg Foundry & Machine Works, Harrisburg, Pa.—The effect of the late election will have a decided tendency to stimulate business. We look forward to a steady increase of orders, all indications pointing that way.

Adam Cook's Sons, Albany grease, New York City.—The effect has already been felt for good in all lines of trade. Confidence is being restored and many new electrical enterprises are being pushed ahead, which all tends to create a better demand for electrical goods.

S. F. Bagg, secretary of the Watertown Steam Engine Company, Watertown, N. Y.—Undoubtedly the result of the election will have a very favorable influence on the steam engine business. At the same time it must unquestionably help the electrical industries.

Frank H. Ball, American Engine Company, Bound Brook, N. J.—I am glad to say that every indication seems to point to a speedy revival of prosperity, and I am confidently expecting a lot of new business that has been held over, awaiting the result of the election.

Thomas L. Proctor, general manager Riker Electric Motor Company, Brooklyn, N. Y.—There can be but one effect upon the business of the country—that which is already apparent. This stimulation will, of course, be felt in the electrical line as well as in others.

W. C. Bryant, manager the Bryant Electric Company, Bridgeport, Conn.—The writer's views are in line with those of most of the business men throughout the country, that is, that business will be better, confidence restored, and we shall have prosperous times in general.

Ernest L. Clark, secretary the Valentine-Clark Company, Chicago.—In my opinion the election of Major McKinley means gradual, healthy increase of business, a broader extending of credits, brought about by the positiveness of sound money and the restoration of confidence.

F. C. Billings, superintendent of the Billings & Spencer Company, Hartford, Conn.—We have already received some orders from large electrical manufacturers that have apparently been withheld until the election was decided. We anticipate good business from now on.

S. M. Hamill, general manager the Brush Electric Company, Cleveland, O.—I believe that the election of William McKinley will have a very beneficial effect on the electric business. We ourselves have a very large amount of business that has been contingent on his election.

I. J. Kusel, president Missouri Telephone Manufacturing Company, St. Louis, Mo.—There is no doubt but that there will be a revival of trade in all lines, particularly in the electrical line. We are preparing for an extremely large trade, and do not think we will be at all disappointed.

H. N. Bates, treasurer H. N. Bates Machine Company, 240 Congress Street, Boston.—We, in common with all other manufacturers and dealers in the East, are very much elated over the turn the election has taken. We hope for and expect an increased volume of business as the result.

C. K. King, secretary The Ohio Brass Company, Mansfield, O.—It seems to be a pretty generally unanimous opinion among those interested in the electric railway business that the election of Mr. McKinley cannot help but be beneficial, and this idea is shared by the members of this company.

Converse D. Marsh, president Bryan-Marsh Company, 136 Liberty Street, New York.—We have every confidence that the recent election will improve business generally, although we ourselves have no reason to complain, our business for the past few months being the largest in our history.

John Wood, Jr., Schuylkill Foundry & Machine Works, Conshohocken, Pa.—Since the election of McKinley reviving confidence has already caused increased inquiry and many orders to be placed, and while it is too soon to expect much we think the works of the country will soon be full of orders.

J. Jones, Jr., of J. Jones & Son, 67 Cortlandt Street, New York.—I am of the opinion, which I understand is the general one, that business will now gradually assume more natural proportions, and I look for prosperity during the best part of the coming administration, the electrical trade getting their share.

Lukens Iron & Steel Company, Coatesville, Pa.—The effect on our product of the recent election has been to cause a considerable tonnage, on which we had given option, to be positively booked, and in consequence the amount of work in our hands has very materially increased within the last few days.

Alfred E. Hunt, president Pittsburg Reduction Company, Pittsburg, Pa.—I believe that the result of the election will very soon lead to a considerable increase in the bulk of general business, and from my knowledge I am quite confident that it will be of special assistance to the electrical business.

Chas. A. Schieren & Co., New York.—We, of course, are rejoiced at the result of the recent election. Business in this country will be all right if it is not tinkered with, and if it is given a fair chance. The country will be safe for four years hence, so we may go ahead cheerfully and enthusiastically to do business.

The Lakon Company, Elkhart, Ind.—It is our opinion that electrical industries and manufacturers of the United States in general will experience an era of prosperity for several years to come, which will (if such a thing is possible) surpass any of the prosperous periods witnessed during the past quarter century.

Edw. W. Hooker, secretary and treasurer The Perkins Electric Switch Manufacturing Company, Hartford, Conn.—We believe that there can be but one opinion as to the effect of the recent election on all business. We certainly expect that our orders and sales will increase and that collections will immediately be easier.

R. E. Gallaher, secretary New York Insulated Wire Company, New York.—I think the starting up of the factories all over the country indicate very clearly the good result of Mr. McKinley's election, and while I do not anticipate a big boom during the remaining months of this year I think 1897 will show great prosperity.

William A. McCallum, general manager The Electric Railway Equipment Company, Cincinnati, O.—Confidence has been restored, without which it is impossible to do business. We look for good business in the Spring, as I think it will take some time to get in position for a full development in all its channels of trade.

GEO. T. EYANSON, of Eyanson & Armpriester, Philadelphia, Pa.—The United States is one large factory; we are the workers; and with a man at the helm with McKinley's views of protection gives us heart to hold up our head, and make us determined to try. May we realize all our hopes; I think we will.

THOS. C. WOOD, president Ball & Wood Company, New York.—The effect of the sound-money victory of Tuesday can hardly be overestimated as it bears upon the business situation. It restores confidence, and this is really all that need be said. The electrical industries, of course, share in the general improvement.

JAMES POWELL, president Wm. Powell Company, Cincinnati, O.—As to the effect of the election on business, it has already started the wheels of commerce and manufacture, and we are, no doubt, on the eve of a prosperous return of business in all its branches. In this the electrical trades will enjoy a full share of prosperity.

THE EDWARD P. ALLIS COMPANY, Milwaukee, Wis.—We have received orders for two extremely large engines for a steel mill, and for a 1200-hp direct-coupled engine for street railway work. We have received other smaller orders. We judge from this that the tide has turned, and improvements long deferred will now be carried out.

A. J. WRIGHT, president the Reliance Gauge Company, Cleveland, O.—I never saw a time when people generally were so anxious to do business as they are at present. No man who has kept in touch with the business world for the past few months as I have can entertain any doubt whatever that renewed activity and prosperity are sure.

R. R. DICKEY, JR., secretary Dayton Globe Iron Works Company, Dayton, O.—It is our opinion that the election of Major McKinley will have the effect of restoring confidence both at home and abroad, bring money back into circulation which has been hoarded and induce capitalists to invest their money in new enterprises.

JOS. E. LOCKWOOD, president Michigan Electric Company, Detroit, Mich.—We are sure that the result will not only improve business in all lines, but that it will particularly improve business in the electrical line. In general our faith is strengthened, and we are now planning with strong confidence for a large year's business during '97.

F. FOSDICK, president Fitchburg Steam Engine Company, Fitchburg, Mass.—I believe that the recent election will have an immediately beneficial effect on business in general, and it seems to me that the country is upon an excellent basis for clean, solid business as soon as confidence in the above directions shall be established.

H. A. REED, secretary Bishop Gutta-Percha Company, New York.—In my opinion had McKinley been defeated, business and credits would have been paralyzed to a greater extent than at any time since the shock caused by the fall of Fort Sumpter and the defeat at Bull Run. We cannot expect the immediate return of the prosperity of 1892.

M. L. LIVINGSTON, assistant manager Standard Thermometer & Electric Company, Peabody, Mass.—If we are to judge what effect the result of the election will have on general business by the numerous promises we have been receiving for the past month or two, I should say that there will be a gradual and lasting change for the better.

A. H. BLACKBURN, general manager Fuel Economizer Company, Matteawan, N. J.—I think the result of the election will have a very good effect on business and that we are commencing four years of prosperity. It will, of course, take a short time for financial matters to adjust themselves. When confidence returns business always improves.

LIEUT. F. B. BADT, secretary Siemens & Halske Electric Company of America, Chicago, Ill.—I believe that the outcome of the recent election will have a very beneficial effect on business generally, and on electrical business in particular. For the last few days the number of inquiries concerning the purchase of electrical machinery have greatly increased.

CHAS. A. SCHENCK, general manager National Water Tube Boiler Company, New Brunswick, N. J.—The writer's belief is that now that the great question that has disturbed all business interests has been settled, and the assurance of currency to our country and to protection gives promise to an early and genuine revival in every branch of trade and industry.

J. W. MARSH, vice-president and general manager Standard Underground Cable Company, Pittsburg, Pa.—I believe that the recent election will result in the speedy revival of business in general. I do not, however, anticipate any extraordinary activity in the electrical trade for a few months, owing to the fact that the season for outdoor work is about closed.

L. SHARPE, treasurer Brown & Sharpe Manufacturing Company, Providence, R. I.—The return of confidence in the soundness of the money in use as the result of the recent election must cause an increase of business in all lines, though it is to be hoped no boom will take place, but rather a steady and healthy increase till the people are fully employed.

H. L. PARKER, president The Emerson Electric Manufacturing Company, St. Louis, Mo.—We are greatly pleased with the general result of the election, and indications bear out our past ideas that such a result would favor the beginning of prosperity. The electrical business, both in manufacturing and merchandising, cannot fail to be greatly benefited.

SEYMOUR SWARTS, president Swarts Metal Refining Company, Chicago.—We have no doubt that the election of McKinley will have a good effect on business in general, especially upon the electrical business. Orders for supplies are also coming in more plentiful, and we are in hopes that within a very short time business will resume its normal condition.

W. A. ALLEN, manager Weston Engine Company, Painted Post, N. Y.—Instead of the feeling of fear and "Don't know," there is a jubilant sentiment of "Go ahead;" and as the inspiration of business is confidence, there is sure to be a revival in all lines of trade at once. We have also received several orders for engines for electric lighting purposes this week.

C. M. WILKINS, of the Partrick & Carter Company, Philadelphia, Pa.—The election of McKinley and Hobart can only result in great good to all branches of our commercial and industrial interests. The electrical business must necessarily feel the effect of restored confidence, as it is largely dependent upon new enterprises in building operations and new construction.

J. E. KEELYN, president Western Telephone Construction Company, Chicago, Ill.—The election result promises freedom from radical changes. Business men are now confident of knowing where they are at. A salutary effect is already apparent. Collections immediately changed for the better, orders are more free, inquiries more general. These conditions need no elucidation.

J. M. THOMAS, treasurer Chicago Belting Company, Chicago.—Confidence was the medicine most needed by the sickly business world, and we got a goodly dose by the recent election. The immediate effects were noticeable in the liberality of the banks, and we are all recovering our usual health and prosperous condition. We do not look for a boom, but for steady, progressive trade.

HENRY HINE, general manager Stanley Electric Manufacturing Company, Pittsfield, Mass.—The electrical business will be particularly benefited, I feel sure, because of actual knowledge of a great deal of development in electrical work which has been hanging fire. I look for some decided immediate improvement, and expect that it will continue, and on sounder financial lines than heretofore.

L. H. ROGERS, manager the Adams-Bagnall Electric Company, Cleveland, O.—The election of McKinley is already having a visible effect upon the industries of the country. We received an order on the morning of Nov. 3 for 50 alternating arc lamps, to be increased to 150 if McKinley should be elected. We therefore had one additional reason for rejoicing at the election of Ohio's favorite son.

H. CHESTON VANSANT, secretary Morris, Tasker & Company, Philadelphia.—There is no reason why manufacturing concerns and people in your own line should not be making money, but I think this advance will be better for us all if it is slow, for then it will be sure. As to our own business, I do not think we will have any marked improvement this winter, but after March next year, I look for very heavy business.

FRED. A. BURNHAM, secretary Gordon-Burnham Battery Company, New York.—I have no doubt whatever that it will restore general confidence in the manufacturing and commercial industries of the country. As regards electrical work it is quite evident that we must feel the effect even more strongly than other branches of business, inasmuch as the trend of progress is toward the substitution of electricity for other energy.

JOSE A. MACHADO, Machado & Roller, New York.—We feel very confident that the return of confidence, due to the result of the election, will result in an immediate improvement in all lines of business. We can testify to an increased number of inquiries for immediate business since election day, and know of many large orders which will now be placed, which have been held in abeyance during the past few months.

H. C. HAWKS, president Anchor Electric Company, Boston.—The recent election had an immediate and beneficial effect on our business, as we had some large orders placed with us dependent upon McKinley's election. We do not, however, look for a sudden boom, in fact, we do not want it; but we do believe that there will be a gradual and healthy increase in general business, and in the electrical business in particular.

RALPH L. SHAINWALD, president The Standard Paint Company, 81 & 83 John Street, New York.—In my judgment the result of the recent election cannot but be beneficial to general business throughout the United States. I look for very good business, especially in the electrical lines, since so much of the enterprise and push of the nation is directly engaged or interested in the development of electrical projects of one kind or another.

FRED. W. MARKS, president of the Electric Arc Light Company, 687–689 Broadway, New York.—There is now a feeling of satisfaction among the merchants and a confidence that the bottom has been reached, and that the gradual restoration of prosperity is at hand; our salesmen are now busy collecting contracts, and there is a stir in our office and factory that is most pleasing. It has become a question of delivery now more than anything else.

JAMES P. MCQUAIDE, secretary the National Conduit Manufacturing Company, and treasurer the National Underground Cable Company, New York.—We think that the election of Mr. McKinley will have a most

beneficial effect on business of all kinds, and particularly in the underground conduit and cable business. In our opinion, next year will be the biggest year in the underground conduit and cable business since the first underground wire was laid.

Frank MacGovern, Rossiter, MacGovern & Co., 107 Liberty Street, New York.—It is my firm belief that the immediate increase in the volume of business for both railway and lighting plants will be considerable. To my personal knowledge several new railways and central stations have been organized for some time ready to install their plants, but were unable to do so from their inability to secure ready cash, but now they anticipate no difficulty in this direction.

Geo. T. Burroughs, president American Battery Company, Chicago, Ill.—With the election of Mr. McKinley, to whom so many of the people of the country looked for relief from all the ills which have beset us, the hoarded money will come out and be added to our circulation, thereby increasing business. We cannot see why the storage battery and all other industries will not come in for a fair share of the general prosperity hoped and confidently looked for.

Chas. F. Thompson, The Lane & Bodley Company, Cincinnati.—The result of the late general election must be beneficial to business. We expect a steady increase in business, but would not be surprised if a year or more would pass by before things are really in a comfortable position again. The electrical business will probably be one of the earliest benefited, especially as municipal plants are largely built on bond issues which can now be sold and are eagerly sought after.

Wm. H. McKinlock, president Metropolitan Electric Company, Chicago, Ill.—We deem the change which has come upon the country will be most salutary, particularly in the electric business, that has been depressed so long. We do not look for any boom, but a steady advancement. With the financial question at rest and the Government placed upon a paying basis we will enter a era of prosperity equal to, if not greater than, any in the history of this country.

J. G. Noyes, general manager National Electric Mfg. Company, Milford, Conn.—There is no doubt whatever but what we have been benefited by the recent election, as we have collected more money in the last two days than we have been able to collect a month or two before election, and up to the present time we have received many orders which we know would not have been sent to us. Our factory will be run full time, and we will probably in a few days take on additional men.

M. E. Fuld, general manager Chloride of Silver Dry Cell Battery Company, Baltimore, Md.—The good results of the recent election are already felt. While we have not suffered any lack of business, we never-theless did feel the stringency in our settlements. Now our receipts are coming in gradually and substantially. Our works have been running full time to meet the demand we felt assured would come, and to-day we are busy to the top notch, and look for a big year in the electrical field.

W. Courtenay, president Vulcanized Fibre Company, 14 Dey Street, New York.—So far as our observation extends, the election of Mr. McKinley will at least double the volume of business being done in the various electrical industries. Many of our smaller customers have already advised us of numerous orders they had, which were only to become operative in case of the success of the "sound money" cause. We are feeling the effect already in our own business and have increased our output.

Wm. O. Vilter, secretary Vilter Manufacturing Company, Milwaukee, Wis.—The election of Mr. Wm. McKinley, in our opinion, will have a tendency to improve business in general, and also the electrical business. Though our business has been good for some time past, we also expect an improvement in our line, and this has manifested itself already in the large number of inquiries we have had recently, a number of our customers stating that upon the election of McKinley, the improvements would be made.

N. B. Buff, manager Williamsport Wooden Pipe Company, Williamsport, Pa.—The result of the recent election is already being felt in our business. On Wednesday morning before 12 o'clock we received a contract which necessitated the running of our plant day and night. This we expect to keep up at least to Jan. 1, 1897, and would not be at all surprised to have it continue until Jan. 1, 1898. There is no question whatever as to the beneficial effect that the result will have on general business throughout the country.

James I. Ayer, general manager American Electric Heating Corporation, Boston.—As has been well said by many eminent men, the triumph of patriotism over party ties has proclaimed to the world that the people of the United States can be relied upon to maintain a substantial form of government. This being demonstrated at a time when all conditions are so favorable for a prosperous era, must set the wheels of commerce in active motion, and there is no question but what the electrical industries will be among the first to show rapid improvement.

Chas. M. Jarvis, president and chief engineer Berlin Iron Bridge Company, East Berlin, Conn.—We believe it is too early as yet to say what effect the recent election will have on business in general. I, however, am of the opinion that there is nothing now in the way to prevent business responding promptly. I do not expect any boom, but if business will gradually expand I believe that by Midsummer we will be back where we were in the Spring of 1892, when every man who sought employment or needed employment was able to find employment.

Thos. J. Creaghead, president Creaghead Engineering Company, Cincinnati, O.—We expect the election of McKinley to make a decided improvement in our business. Owing to the financial uncertainty, it has been impossible to sell electric railway bonds or to interest capital in the construction of gilt-edged projects. We are satisfied that this condition will be removed and that investors during the next season will place a very large amount of money in street railway securities, thereby enabling the construction of a great many miles of electric railway.

Simeon J. Fox, president and treasurer National Pipe Bending Company, New Haven, Conn.—We are quite confident that the emphatic and agreeable result of the recent election will tend to liven up all lines of general business. We already see it to-day in the number of checks that are being received for accounts, which we could not collect last month, also in receipt of orders for new work. It cannot but help the electrical line. The coming year is sure to be a happy one for the manufacturer and the workman, and we anticipate a good healthy resumption of business.

A. Edw. Newton, treasurer the Cutter Electrical & Manufacturing Company, Philadelphia—.It is impossible that the result of the election should not favorably affect the electrical business, as it will indeed business in general throughout the country. The electrical business, like every other, is dependent upon the stability of the dollar, and will, undoubtedly, feel the benefits resulting from sound money victory. The public will again look for investments in street railways, in light, heat and power plants, or in large building operations. This result is not to be looked for in a day or a week, however, nor is this desirable. A slow, steady growth is to be wished for, and we feel that this growth will soon be apparent.

The History of a Telegraph Pole.

Few people who see the prosaic telegraph poles in the streets and along the railways realize the industry that is necessary to procure, assort and deliver the same to the companies that use them. Inasmuch as this portion of the equipment of telegraph and telephone lines is more or less interesting it will be worthy of the attention of our readers.

The Valentine-Clark Company, of Chicago, was incorporated in January, 1892, to carry on such business, with John Valentine as president and Ernest L. Clark as secretary and treasurer. The business was formerly handled by Mr. Clark alone, who started it in May, 1889. The company's plan of operation is a new one. Prior to 1889 cedar poles, which are almost exclusively used for telegraph and telephone work, were always shipped from the woods to the consumer. This involved considerable

Fig. 1.—Pole Yard.

loss of time, delays in securing cars, and required, moreover, that each consumer should have a force of men traveling the country to select timber, close negotiations with the owner, and cut it and ship it. This company saw the necessity of opening central yards where shipments could be made with promptness. The first yard was located at Clare, Mich., 50 miles west of Saginaw, on the Flint & Pere Marquette, and Toledo, Ann Arbor & Michigan Railways. The business rapidly grew and a second yard was necessary, which was located at Green Bay, Wis., on the Chicago & Northwestern, the Chicago, Milwaukee & St. Paul and Green Bay, Winona & St. Paul Railways, and also the Toledo & Ann Arbor Car Ferry, the latter line facilitating matters when a large shipment was necessary for Eastern delivery. The third yard has been recently located at Waukesha, Wis., and greatly facilitates the delivery of poles South and West.

The object in opening these yards was to enable consumers to purchase poles at reasonable prices and at the same time be assured of prompt delivery. The company employs a large corps of men whose business it is to travel the country and make careful note of the stumpage of any plots of cedar that they can possibly purchase. The reports of these men are kept on file at the main office at Chicago (230-

236 La Salle Street), and the company in this way knows exactly how much timber any given tract of land will cut, and is thus in a position to make its deals accordingly. The timber is cut and shipped to the yards and the land is turned over to the State for taxes.

Fig. 1 illustrates one of these pole yards. In the background will be seen poles of various lengths which have just come in from the woods. They are being unloaded and sorted and skidded into piles of even length. Immediately in the foreground poles of exactly the length and butt and top diameter desired are being loaded on cars for shipment. The Valentine-Clark Company carries stock for many of the large pole consumers in the country.

Fig. 2 gives a general view of the yards at Green Bay and shows the enormous number of poles kept in stock. All of the yards are located at railroad division headquarters. It is the practice among railroads to send empty cars at once to division headquarters, and for that reason

FIG. 2.—POLE YARD AT GREEN BAY.

there is no delay in shipment of poles on account of not being able to obtain cars.

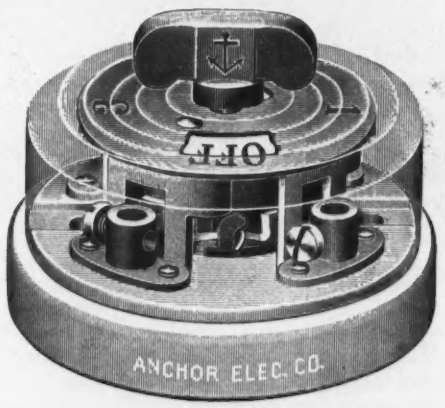
During the present season of 1896 over 2500 carloads of poles have been delivered to the yards, and before the season is over 2000 cars or more additional will have been received. The company has handled between 80,000 and 100,000 poles this year.

Indicator Scale.

Hine & Robertson, 68 Cortlandt Street, New York, have gotten up a cardboard indicator scale which will be found very useful to engineers. There are six different scales on the edges of the board, and as they are engine-divided, they may be regarded as accurate. The scales are divided into 12, 16, 30, 40, 50 and 60 parts to the inch.

Electrolier Switch.

The Anchor Electric Company, Boston, is always presenting something new to the electrical trade, and its switch manufactures have hitherto commanded liberal business recognition, because of their many advantages, durability and handsome appearance. The Anchor electrolier switch is something new, and is illustrated herewith. With this switch three different combinations or groups of lamps in an electrolier may be controlled. One turn of the handle lights the first group, another turn lights a second group, a third turn lights all the lamps, while a fourth turns them all out. This switch is also made with flush plate and with indicating dial.



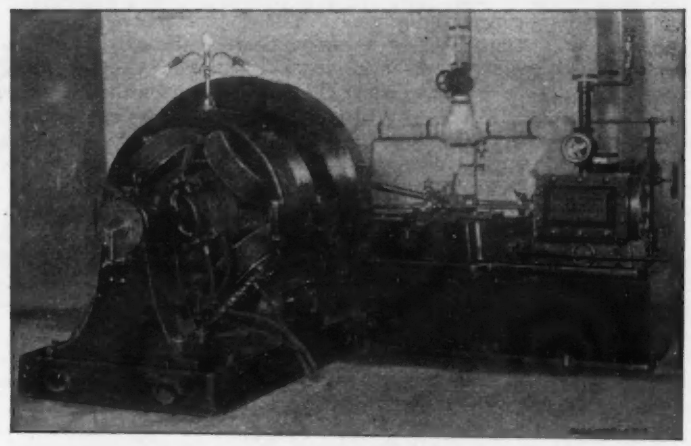
NEW SWITCH.

Electric Plant in the Majestic Building, Indianapolis, Ind.

The Majestic Building is the largest and most complete modern office building in the City of Indianapolis at the present time, and its electrical equipment is commensurate with the character of the structure. The building, while moderate in size compared with the sky-scrapers of New York and Chicago, is looked upon as a model and has been very favorably commented upon by building experts as being perhaps one of the finest structures of its size in the country.

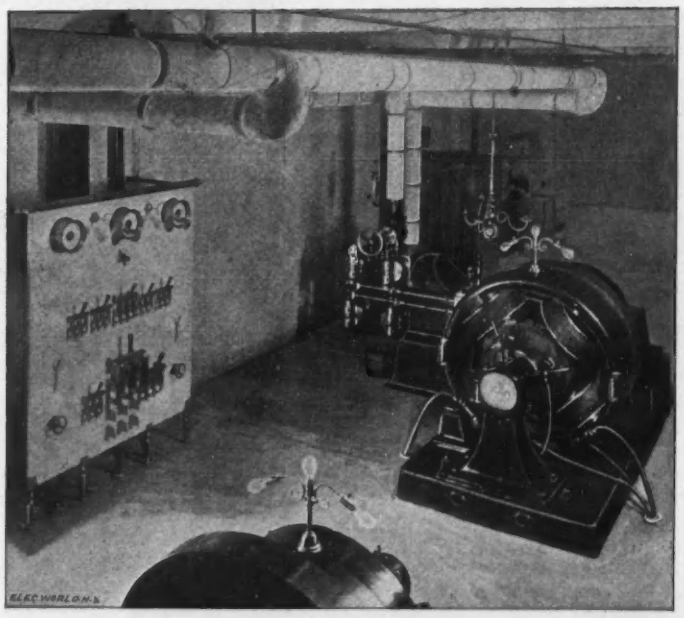
The Majestic is 10 stories high and was designed by a well-known architect of Indianapolis, while the electrical work was installed under the supervision of Mr. Thomas A. Wynne, of the Indianapolis Light & Power Company, who acted as consulting engineer.

The electric lighting plant, in plan and installation, follows the ordinary and most approved practice. There are two direct-connected units, one being about twice the size of the other and is used alone or in conjunction with the smaller one for the heavy evening loads, while the smaller unit is used alone for the day load.



ONE OF THE UNITS, MAJESTIC BUILDING.

The plant was designed and installed by the Commercial Electric Company of Indianapolis. It consists of a 20-kw generator and a 53-kw generator, each being direct coupled to an Atlas engine, and an elegant marble switchboard consisting of a single slab of heavy Italian marble, 6 x 6½ feet, bearing the instruments and switches for two machines and five circuits, into which the wiring of the building is sub-divided. The board also carries a large three-pole double-throw switch, by the use of which the entire wiring can be changed from the two-wire to the three-wire system and thrown on the street mains of the light and power company, in case of any failure of the house plant. The large generator runs at a speed of 225 r.p.m., and the smaller one at 300 r.p.m. They have smooth-core, surface-wound armatures of the gramme ring type, with formed coils and cast-steel magnet frames.



ENGINE ROOM AND SWITCHBOARD, MAJESTIC BUILDING.

Wire gauze brushes are used and the reaction and change of load are so small that the entire load may be thrown off or on either machine without resultant sparking and without requiring any shifting of the brushes.

The wiring on the building is run in iron-armored conduit.

An interesting feature of the plant is that natural gas is used as fuel for the boilers. The usual equipment of elevators, pumps, etc., is placed in the basement alongside the dynamo room, and ample space has been

The Enclosed-Arc Feeding Mechanism.

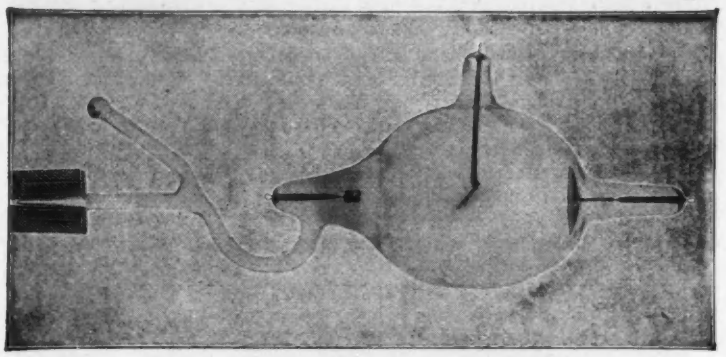
A few years ago, before the enclosed-arc method of illumination had become a practical idea and an established fact, most all arc lamps consisted of complicated mechanisms requiring frequent adjustment and repairs. The adoption of a clutch lamp for constant-potential work resulted in greater simplicity and regularity of action and overcame the greatest objections to the old-style lamps. The adjustment springs and other variable parts in the old lamps were dropped; the geared wheels, and rack and pinion were replaced by the clutch shoes and smooth carbon rod; in fact the clutch lamp adapted to spring a long arc is vastly different from the old arc lamps.

The regulating mechanism of the "Pioneer" lamp, made by the Electric Arc Lamp Company, New York, is claimed to be the simplest and most efficient yet invented. A glance at the accompanying cut will show that the arc is sprung by a pair of solenoids, which lift the armature and lazy clutch and with them the rod. The coils are so designed as to spring an arc of between four and five amperes in the standard lamp and the amount of iron in the moving parts is so proportioned that the current is practically constant for any position of the armature. The lamp will pick and maintain an arc about three eighths of an inch in length. As the carbons waste away the armature gradually descends until the clutch mechanism rests on the stops, as shown in the cut. This releases the rod and allows the upper carbon to feed. The clutch is then instantly raised slightly from the stops. The feeding of the lamp is almost imperceptible and unattended by any flickering in the light. It will be noted that there are no springs, wheels or other adjustable parts in the mechanism; hence there is nothing to get out of adjustment. When the carbon rod has reached the lower limit of its travel the lamp is automatically cut out of circuit. The regulation is so close that the lamps will operate as well on motor circuits in which the voltage varies greatly at different times of the day as on incandescent lighting circuits of practically constant voltage.

Feeding Mechanism.

Improved Crookes Tube.

The high-frequency coil has become recognized as among the most efficient apparatus for the production of Röntgen rays. Of course, for the best results the best apparatus must be used.



Crookes Tube.

The L. E. Knott Apparatus Company, Boston, Mass., has just devised a special form of Crookes tube for use in connection with the production of Röntgen rays. This tube is known as the double reflector, and has proved to be a very powerful apparatus. For photographic work, however, there seems to be a blurred effect, due to the two excited points of the platinum electrode. This in some cases has proved to be quite a serious objection. Many have supposed that this blurring necessarily resulted from the use of the alternating current. The L. E. Knott Company, however, claims to have definitely proven that such is not the case, and that it is possible to obtain with the alternating current the very finest results. The tube is so arranged that the platinum is excited only at a single point, thus attaining the powerful fluorescence produced by the alternating current, also the clear definition secured in the static machine. This arrangement, together with the adjustable vacuum, ensures a tube of great practical utility, and the Knott Company regards this apparatus as an important step in the development of the practical application of Röntgen rays.

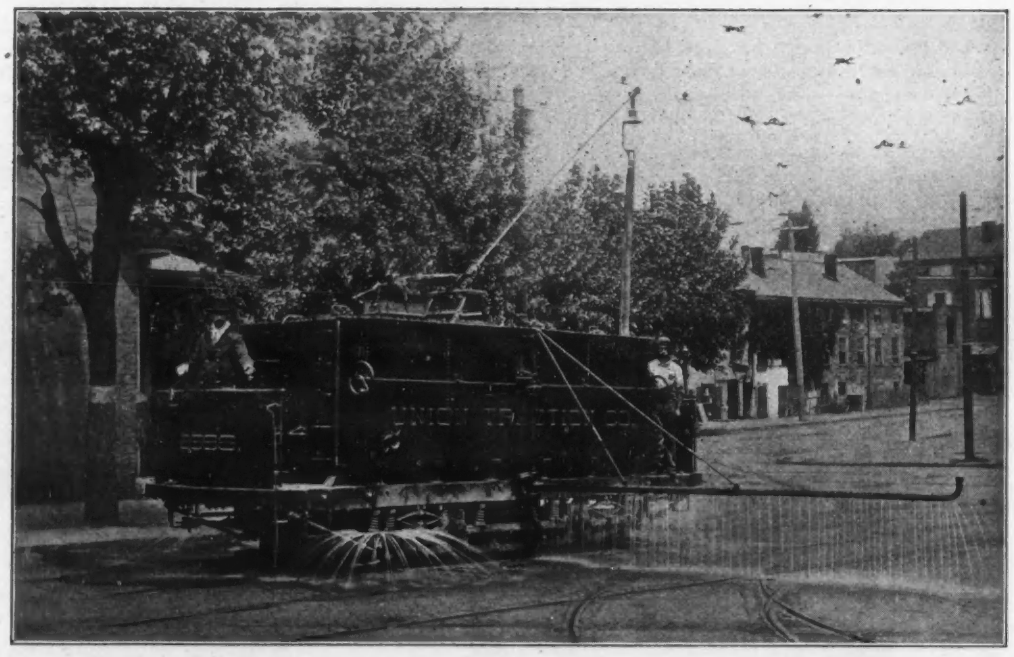
The Kensington Sprinkling Car.

The sprinkling car shown in the accompanying illustration is built by the Kensington Engine Works, Ltd., Philadelphia, Pa., and combines in its design and construction a number of new and valuable features. It is provided with a tank 16 feet long having a capacity of 3000 gallons; enough, it has been demonstrated, to effectually sprinkle about three miles of road.

The tank is made of plate steel and provided with six baffle plates extending from side to side, making seven compartments, communicating with each other by triangular openings in the corners of the plates, preventing swash of the water in case of violent stopping of the car.

Manholes and openings for filling the tank conveniently and quickly are provided at the top, and there are two hose connections arranged at the ends on opposite sides for filling from plugs when desired.

Ladders from the front and rear platforms give easy access to the top of the tank and float tell-tales at each end indicate the height of water carried at all times.



Sprinkling Car.

To sprinkle over the track and within a short distance upon each side, perforated pipes are provided at both ends of the car; these curve outward and return to the side of the truck.

To sprinkle the street a considerable distance on both sides of the track, two swinging arms are provided with perforated pipes carried on cranes that swing in half a circle, with a radius of about 18 feet, making a total width of road sprinkled of over 45 feet. These arms are worked from either platform, by hand wheels actuating a worm-engaging wheel on the post of the crane. In case of necessity these arms can be swung against the car in 10 seconds, and are then entirely out of the way.

The water valves are of quick-opening design and are placed beneath the car. They are worked by levers on the car platform, so that control of the entire apparatus can be had from either or both platforms. The Kensington sprinkling car is mounted upon the standard trucks and driven by the usual motors and electrical attachments.

The Union Traction Company has equipped its entire lines in Philadelphia with these cars, using 11 for the work.

Incandescent Lamp Adjuster.

LAMP ADJUSTER.

The accompanying illustration represents a simple and effective lamp adjuster, which is manufactured by the Nassau Electric Manufacturing Company, Brooklyn, N. Y. The device acts on the general principle of a window-shade roller, and by its use a lamp may be placed at any elevation by simply giving the cord a sharp pull at first, and then allowing the spring to wind the cord until a suitable height of the lamp has been attained. The spring locks itself by holding the cord for a moment. It is sufficiently strong to hold the weight of the lamp and shade, and it has no complicated parts to get out of order and cause trouble. This adjuster is a serviceable device, and no doubt will find favor among those who require adjusting of their lights. It is attached to the electric cord by insulating fibre, and can be put on by any one in a few moments.

Important to Steam Users.

BY GEORGE W. LORD.

It is well known to all competent observers that the usual system of boiler management, as practiced in the average steam plant of to-day, is accompanied with great waste of fuel, and much preventable wear and tear, as regards its equipment; and further, that comparatively little attention is paid to this matter by steam users, either from habitual indifference to this extravagance, or through ignorance of its occasion. Among mechanical experts and inventors the subject of boiler economy has always been a matter of the deepest thought and profoundest study, and every detail of boiler designing and construction that would promise even the smallest economy in the expense of boiler operation and wear and tear has been embraced and diligently studied, until through repeated evolutionary stages our best modern types of boilers have been evolved and reached their present highly acceptable and economic form.

Comparing the performance of these latest improved types of steam generators, when managed by able attendants, under fair conditions, with their service in ordinary practice, the widest divergence is seen, both as regards their economic and steaming efficiencies, and it may be said with the utmost emphasis that in the great majority of steam plants a saving of from 10 to 25 per cent. can easily be attained in the cost of operation and maintenance, would boiler owners only show a greater disposition to observe some of the fundamental and elementary rules underlying efficient boiler management.

The principal difficulty which antagonizes the economical operation of steam boilers is boiler incrustation, and it is clearly manifest that unless this evil is energetically and effectually prevented no boiler can render safe, efficient and economical service.

The ever present conditions which lead to the formation of incrustation in steam boilers are the result of the well-known powerful solvent action of natural waters, which in a greater or less degree are capable of dissolving almost every substance with which they are brought in contact. As this solvent power was invested in natural waters, so as to enable them to play their allotted part in the economy of nature, it follows that boiler feed-waters are seldom obtainable free from foreign impurity, but in the great majority of cases are impregnated with dissolved and suspended matter, varying in nature and proportion with the source of the water and the character of the soils which it traverses.

As these solid matters, which principally consist of the sulphate of lime, the carbonate of lime and magnesia, silica and alumina are of a non-volatile nature, they are eventually precipitated in the boiler by the elevation of temperature, primarily forming a soft sedimentary deposit, which sooner or later becomes baked into a hard, stone-like scale, which energetically resists the transmission of heat through the heating surfaces to the water, and causes a dangerous overheating, and violent expansion and contraction of the sheets, tubes and flues, resulting in the speedy decay and abandonment of the boiler.

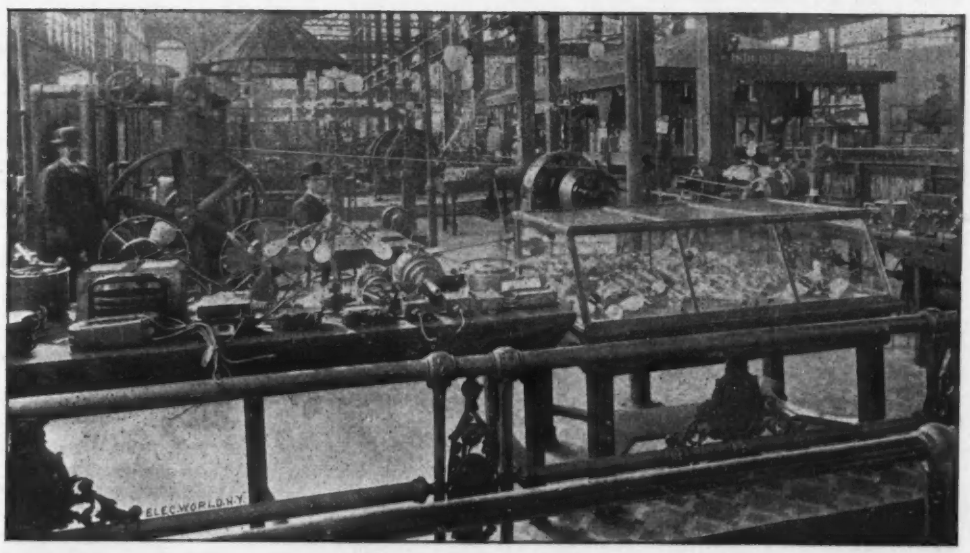
Very few steam users have any adequate conception of the enormous amount of water that a steam boiler evaporates in a year, and the total amount of solid matter which may be deposited in it in the form of scale, even though the water contained only a few grains of solid matter per gallon. Let us suppose a 100-hp boiler be worked 10 hours a day and 300 days a year. Furthermore, let us assume that 15 pounds of water are evaporated per hour for each horse-power developed, and that each gallon of feed-water contains 30 grains of solid matter in solution. Then the quantity of water evaporated in the course of a year will be 100 × 15 × 10 × 300 = 4,500,000 pounds.

As a gallon of water weighs about eight and a third pounds, this is equivalent to 4,500,000 divided by eight and a third or 540,000 gallons per year. As the solid matter present does not pass off with the steam, it must accumulate in the boiler. Then as there are 30 grains of solid matter in each gallon of water, the total weight of the deposit will be 540,000 × 30 = 16,200,000 grains; this is equivalent to 2314 pounds, or more than one ton of solid matter in the course of a year. Of course this condition could not exist in practice, for if some means were not employed to remove these accumulations before they reached such great proportions, the boiler would be destroyed and burned out long before the year elapsed, but the writer has seen many boilers in which hundreds of pounds of scale existed, and these are not rare exceptions as boiler inspectors will testify.

All mechanical experts who have studied this question thoroughly are of the unanimous opinion that chemical means are the only ones available which will effectually prevent this difficulty, and the only intelligent way to meet the situation is to consult some expert water chemist who makes water chemistry his particular specialty. Those who will follow this course will avoid much trouble and expense and save themselves from much imposition.

The Westinghouse Exhibit at the Pittsburg Exposition.

The eighth annual exposition in Pittsburg has now been opened for several weeks and has been visited by a great many thousand people since its opening. It is generally agreed among those who have seen the exhibits that the management has been more successful this year than heretofore in getting together interesting industrial features. This is especially true in the case of electrical exhibits. Pittsburg being the home of the Westinghouse Electric & Manufacturing Company, its display is naturally very extensive, interesting and instructive. The entire



THE WESTINGHOUSE EXHIBIT.

eastern wall of the Mechanical Hall is covered with a colossal sign composed of incandescent lamps, the current for which is generated by a dynamo located in the main exhibit in Machinery Hall. In this main exhibit the company also has displayed a number of electrical instruments in constant operation. An engineer from the company is in charge of the exhibit and explains to the visitors the principles of the different apparatus on view. A very interesting feature of this year's exposition are the different types of gas engines that are shown, of which there are six. The gas engine manufactured by the Westinghouse Machine Company is one of the most interesting; it was developed by Mr. George Westinghouse. This gas engine is direct-connected to an electric generator and is in constant operation in the exhibit.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Nov. 7, 1896.

ELECTRICAL STOCKS.--The election of the sound money candidates exerted a stimulating effect on the general market, prices without exception advancing 2 points or more. Edison Electric Illuminating, of New York, closed at an increase of 3 points; Electric Storage Battery 2, preferred 3½; General Electric common 6, preferred 2; Westinghouse common 3, preferred ½. The electrical bond list also showed some extraordinary activity, the principal securities commanding better prices.

TELEGRAPHS AND TELEPHONES felt the influence of the better feeling as a result of the election, and a general advance is recorded. Bell Telephone closed at an advance of 6¼ points as compared with last week's close; Erie Telephone and New England Telephone each made substantial gains, the former closing at 10 points higher than last week's quotations, and the latter 4. Western Union Telegraph closed at 87⅞ bid, an advance of 3, and Postal Telegraph with a gain of 7 points.

ELECTRIC TRACTIONS.—This class of securities took a decided jump, general advances being recorded.

THE EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.—Notice is given to holders of convertible debenture certificates of the Edison Electric Illuminating Company of Boston, due May 1, 1901, who are desirous of availing themselves of the privilege of conversion into common stock at par, to communicate with the treasurer of the company.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	..	..
Edison Electric Ill., New York	100	97	104
" " " Brooklyn	100	88	93
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	29½	30
Electric Storage, pref	100	33	33½
General Electric	100	34½	34¾
General Electric, pref	100	70	72
Westinghouse Consolidated, com	50	25	27
" " pref	50	50	..

BONDS.

Edison Electric Ill., New York	105	103¼	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	92½	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	210	..
American District Telegraph	100	*29	39
American Telegraph & Cable	100	90	93
Central & South American Telegraph	100	124	127
Commercial Cables	100	150	..
Erie Telephone	100	65	66
New England Telephone	100	100	..
Postal Telegraph-Cable	100	85	88
Western Union Telegraph	100	87⅞	88

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	18⅝	18¾
Brooklyn Rapid Transit		24⅞	25
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	78	80
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	43	45
Hestonville	100	50	50½
" pref		..	62½
New Orleans Traction	100	9½	11
" " pref	100	38	40
North Shore Traction	100	24	26
" " pref	100	76	80
Rochester St. Ry	..	17	20
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	104
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	70	..
" " pref	100	89¾	90½
Worcester Traction	100	17	20
" " pref	100	91	93

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	78	..
Buffalo St. Ry. 1st con. 5s	100	105	*107
Cleveland Elec. Ry. 1st mtge 5s	100	100	*103
*Columbus St. Ry. 1st 5s	100	90	*95
Rochester St. Ry. 1st 5s	100	..	98
Union Railway (Huckleberry) 1st mtge 5s		*101	105
*Westchester Electric 1st mtge 5s	100	100	103

* With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Nov. 9, 1896.

THE ANSONIA BRASS & COPPER COMPANY, New York, announce to the trade the engagement of Mr. Frank X. Cicott with that company. Mr. Cicott will represent the electrical and metal departments of the business.

MR. H. P. COPELAND, who was until recently connected with the E. S. Greeley & Co., 5 and 7 Dey Street, New York, is now in charge of the electrical supply department of Messrs. James S. Barron & Co., 147 West Broadway, New York.

AJAX ARC LAMP.—The new Ajax 150-hour arc lamp, manufactured by Pomeroy, Woltman & Co., New York, is growing very popular as is evidenced by the fact that a third order has been received from two concerns within the past month.

MR. L. E. FRORUP, general sales agent of Schiff, Jordan & Co., has just returned from a Western trip, which has proven to be exceedingly gratifying to himself and General Manager Straschenow. Mr. Frorup brought home some very large contracts for carbons from some of the leading electric light stations in the West.

SPEED OF TROLLEY CARS.—Judge Hurd, in the County Court, Brooklyn, has reversed the ruling of the lower court in the suit of the city against the Nassau Electric Railway Company. The road was fined for violating the ordinance regulating the speed of trolley cars, and it stated that this new decision will affect 60 other cases.

MR. A. A. ZEIGLER, president and general manager of the Zeigler Electric Company, Boston, Mass., paid his respects to THE ELECTRICAL WORLD a few days ago. Mr. Zeigler stated that the business prospects of his company were excellent, and that the company's new catalogue has met with a very favorable reception in the electrical trades.

TEST CASE.—The Board of Electrical Control has decided to refuse the application of the East Chester Electric Light Company to erect poles and string wires in the recently annexed district of the village of Wakefield. The company's plant is situated in Mount Vernon. This action, it is stated, has been taken for the purpose of making it a test case and to determine whether a company whose plant is outside the city limits may furnish electric lighting within the city limits.

MAGNETIC CLUB.—The Autumn meeting of the Magnetic Club will be held at "The Tuxedo," corner of Madison Avenue and Fifty-ninth Street, on the evening of Nov 18. In the afternoon of that date the annual meeting of the Telegraphers' Mutual Benefit Association will be held, and the members will combine with the Magnetic Club in making the dinner one of extraordinary interest. An excellent menu is provided, and the after-dinner entertainment will be of the most interesting character.

THE KINSMAN LONG-BURNING ARC LAMP.—In our last issue we published an article under the head of "Long-Burning Arc Lamp for Incandescent Circuits," in which the name of the inventor of the lamp was erroneously given as Mr. F. E. Kinsman. That gentleman has called our attention to the error, and in a letter states that the credit of developing the lamp described is due entirely to Mr. Fred A. Kinsman, president and general manager of the Electric Construction & Supply Company. Mr. F. E. Kinsman speaks in the highest praise of the lamp, which he says reflects great credit on the inventor of the same. Mr. F. A. Kinsman and F. E. Kinsman, while related one to the another as uncle and nephew, are both well known in the electrical trade, and to the similarity of initials was due the error.

THE ELECTRICAL DIVISION OF THE SOUND-MONEY PARADE.—On Saturday, Oct. 31, an immense sound-money parade took place in New York City, consuming practically the entire afternoon in its march. It is stated that there were over 100,000 men in line, and this large body represented the various trades and industries in the city. The electrical trades were largely represented by a full turn-out, and it was a pleasing sight to witness so many familiar faces marching like veteran warriors. For the purpose of gaining admittance to the parade, the Electrical Sound-Money Club was organized, and its numerical proportions far exceeded the calculations of the promoters. The Electrical Club formed a separate division of the parade and was headed by Gen. C. H. Barney, who acted as marshal. The line consisted of the officers of the club, followed by the Crocker-Wheeler regiment, which was preceeded by a brass band. This regiment included officials and employees from the Crocker-Wheeler Works and the Sprague Electric Elevator Works, and numbered nearly 500 men. Then came representatives of the telephone and telegraph companies and electric wire interests. The employees of the Interior Conduit & Insulation Company, which came next in order, were followed by the employees of the E. S. Greeley & Co., the Okonite Company and other concerns of like nature. Altogether there were 1830 men in line and they marched remarkably well. The electrical division was applauded all along the line for its fine appearance and soldierly bearing, and it was indeed creditable to the electrical business to be so excellently represented on this occasion.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Nov. 6, 1896.

IMPROVED CAR HEATERS.—Notwithstanding the general conditions that prevail, the American Electric Heating Corporation, of Boston and Chicago, reports extensive business in its improved car heaters. The number shipped this season to date runs up into the thousands This is certainly encouraging, for it indicates a general adoption of electric car heaters in the place of the obnoxious stove.

MR. S. R. KNEELAND, of the Kneeland Reflector Company, Boston, has just returned from quite an extended trip through the Western and Southern States, and has captured some mighty good orders for the reflector shades manufactured by this company. Mr. Kneeland is the pioneer in the reflector business and his increased energy with the electrical trade is reaping for his company some telling results.

INCREASING ITS PLANT.—The Lynn Incandescent Lamp Company, Lynn, Mass., reports that its business at the present time is so extensive as to greatly test its present facilities, and in order to do justice to the trade the company is increasing its plant, which improvements will give it ample facilities to turn out its work more rapidly. The extensions contemplate a plant with a capacity of 10,000 lamps per day.

THE KENT ELECTRIC MANUFACTURING COMPANY, Worcester, Mass., has just issued a very neat little catalogue, in which is conspicuously presented its line of alternating-current motors, battery motors and light power specialties. The new alternating sewing machine motor, the more recent manufacture of this company, is commanding considerable attention and good orders for it are being received The business success of this company proves that Mr. Arthur A. Kent, its manager, has good business qualities to back up his inventive mind and genius.

THE CROWN WOVEN WIRE BRUSH COMPANY, Salem, Mass., has recently appointed as its agents the Osburn Electric Supply Company, Chicago, Ill., and the Michigan Electric Company, Detroit, Mich. Manager F. S. Burke and Treasurer J. Orne Ryder report business for the Crown woven wire dynamo brushes as constantly increasing, and that additional manufacturing facilities are being acquired that orders may be filled with promptness. This company has certainly obtained a strong foothold and its success is undoubtedly due to the excellence of its brush manufactures and energetic business management.

A USEFUL BOOK.—The Zeigler Electric Company, 141 Franklin Street, Boston, Mass., has issued a little book containing some very interesting and valuable tables and information. Every electrical engineer will find this work very handy, as it gives valuable tables and formulæ and various diagrams of connections of electrical apparatus and systems Among the contents of the book may be mentioned wiring tables, wiring formulæ, wire gauge tables, belt rules, resistance tables, tables of sines and tangents, diagrams of bell circuits, induction coils, burglar alarms, Wheatstone bridge, electric lighting systems, telephone connections, etc., etc.

ANCHOR ELECTRIC COMPANY.—Mr. W. O. Turner, who has been identified with the book-keeping department of this company from the time it began business, has become one of its traveling representatives, his territory being southwestern Massachusetts, Connecticut and Rhode Island. Mr. Turner possesses first-class business qualities and indomitable energy, and the officials of the Anchor Company, together with others, believe that he will score some good business success. If he can capture the orders as fast as has Mr. C. H. Clark, the Anchor representative for northeastern Massachusetts, Maine and New Hampshire, he will have every reason to congratulate himself, and the Anchor Company itself.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, ILL., Nov. 5, 1896.

MR. J. G. POMEROY, who has been on the road for several years representing the Adams-Bagnall Electric Company in the West, has recently taken charge of the Chicago office of that company as Western manager.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY.—Mr. W. A. Bisland has been elected vice-president of the Western Telephone Construction Company, Chicago, in place of Mr. George F. Stitch, who is no longer connected with the company.

MR. A. W. DEE.—The numerous friends of Mr. A. W. Dee, of Chicago, Ill., will be pleased, no doubt, to learn of his connection with the Dearborn Electric Company of that city. This young but energetic company is now carrying a full line of electrical goods and is pressing hard for business.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Oct. 28, 1896.

THE LIVERPOOL CORPORATION AND ELECTRIC TRACTION.—The Liverpool Corporation, which recently purchased the local electric light undertaking, for the sum of £400,000, is now contemplating the purchase of the local railway and omnibus undertaking with a view to the adoption of municipal electric traction.

AN ELECTRIC LIGHTING STATION INSIDE A FORT.—Quite recently the Electric Lighting Committee of the Dublin Corporation visited the Pigeon House Fort with the object of determining if it would be a suitable spot for an electric lighting station large enough to light the entire city. The deputation spent some three hours in making its inspection, and its members were unanimous in expressing their approval of the proposal. The fort in question has been sold to the Corporation by the military authorities and possession will be obtained at the beginning of next year. The present municipal station of Dublin is in the middle of the town, and owing to its central position the best steam coal has to be used at a cost of £3500 per annum. The cost of a similar amount of inferior coal delivered at the proposed central station in the Pigeon House Fort would only cost some £1200.

THE UNDERGROUND RAILWAY AND ELECTRIC TRACTION.—The opinion seems to be gaining ground that the announcement of an electric traction scheme in connection with the Metropolitan District Railway, to which I referred in a recent letter, was made more with a view to justifying the recent rise in the stocks of the company than with an eye to business. The conclusion of the whole matter would seem to be that here, as in every other case of recent years, it is exceedingly difficult to see how a commercial profit can be made out of supplying the undoubtedly growing needs of the London public in the matter of rapid transit. In the case of the Earls Court and Mansion House sub-district line the thing may possibly be done by means of economical electric traction and careful management. There is, however, no margin for company-mongering profits, and it is difficult to see where the justification came in for the recent 40 per cent. rise in the market quotation of Metropolitan District Railway stock.

FREE LAMPS.—The Gas and Electricity Committee of the Bradford Corporation has decided to supply consumers with new lamps free of cost. By this decision the committee has at one stroke settled the difficulties attendant upon the introduction of the 200-volt lamp, and silenced the complaints which are now so common about the short life and small candle-power of the numerous varieties of cheap and unsatisfactory lamps now upon the market. It is not proposed to give consumers lamps *ad lib.*, but to estimate the number of lamps they are entitled to, upon the number of units consumed by them per quarter. At the same time that the last quarter's bill is sent in to the consumer he will be informed that he is entitled to such and such a number of 8-cp glow lamps or their equivalent, if he cares to send to the central station for them. Of course all glow lamps sent out to consumers will be tested. It has also been decided at Bradford to let out small motors (1½ horse-power to 6 horse-power) on hire. It is only now required that the house wiring should be done for nothing to make the life of the electricity consumer completely happy.

General News.

NEW INCORPORATIONS.

THE CORNING HEAT, LIGHT & POWER COMPANY, Corning, N. Y., has been organized. Those interested are A. D. Welsh, Hosea A. Clark and others.

THE NEW YORK LIGHTING COMPANY has been incorporated in Camden, N. J., for the purpose of supplying light, heat and power. The capital stock is $10,000.

THE BRITISH COLUMBIA ELECTRIC COMPANY, Tacoma, Wash., has been formed by W. L. Thompson, J. M. Bell, C. M. Johnson and Gustave Silbon. Capital stock, $10,000.

THE GIBBS ELECTRIC MANUFACTURING COMPANY, Newark, N. J., has been incorporated by Jacob S. Gibbs, Charles A. Clark and Charles B. Gibbs. Capital stock, $100,000.

THE BURLINGTON RAILWAY & LIGHT COMPANY, Burlington, Ia., has been formed with a capital stock of $1,250,000. The incorporators are J. J. Ransom, O. H. Higby, E. C. Walsh, A. E. Walsh and C. H. Walsh.

THE LOMIRA TELEPHONE COMPANY, Lomira, Wis., has been incorporated with a capital stock of $1000. The incorporators are John Buerger, Henry McCarty, William H. Hoppe, F M. Baker, William Schultz and B. Joneley.

THE BURLINGTON RAILWAY & LIGHT COMPANY, Burlington, Ia., has been incorporated with a capital stock of $1,250,000. The object of the company is to own and operate steam and street car lines, electric light and power plants.

THE GREATER NEW YORK ELECTRIC LIGHT & POWER COMPANY, New York, N. Y., has been organized by Jacob Fleischhauer, Allen Lexow, Charles K. Lexow and others, of New York City. Capital stock, $50,000.

THE SUNAPEE ELECTRIC LIGHT & POWER COMPANY, Sunapee, N. H., has been incorporated with a capital stock of $4,000. The incorporators are A. F. Stocker, William C. Stocker, C. E. Trow, W. W. Trow and Joseph Russell.

THE BEACON LIGHT COMPANY, Chester, Pa., has been granted a charter. Its capital stock is $120,000. The directors are: George C. Hetzel, of Ridley Park; L. E. Cockran, Jr., Henry B. Black, Chester, Pa., J. G. Kealber and Albert Will, Rochester, N. Y.

THE BELL ELECTRIC COMPANY, New York, N. Y., has been formed with a capital stock of $150,000, for the purpose of dealing in electrical appliances. The incorporators are Clifford W. E. Porter, Frank M. Bell and John R. Kein, of New York City, and others.

A COMPANY has been formed in Philadelphia, Pa., having for its object the operation of trolley railways in lower and central Bucks County. Those interested are Joseph D. Reall, New York; A. S. Cadwallader, Yardley, Pa.; Dr. J. N. Richards, Fallsington, and R. Duncan Harris, of New York.

THE OHIO RIVER ELECTRIC STREET RAILWAY COMPANY, Pittsburg, Pa., has been formed for the purpose of building an electric street railway in the borough of Bellevue, Pa. The incorporators are J. N. Davidson, A. M. O'Brien and Frank Oliver, Allegheny, Pa. Capital stock, $36,000.

THE SEWICKLEY VALLEY ELECTRIC STREET RAILWAY COMPANY, Pittsburg, Pa., has been incorporated for the purpose of building an electric street railway in Glenfield and Sewickley boroughs, Pa. Those interested are J. N. Davidson, A. M. O'Brien and Frank Oliver, Allegheny, Pa. Capital stock, $30,000.

Telegraph and Telephone.

MILAN, ILL.—The Marshall-Tobie Telephone Company proposes to operate in this county and in Mercer County.

SPARTA, TENN.—Telephone line connecting Sparta with Cookville, Livingston, Salina, Gainesborough, Carthage and other towns is to be built.

NEW ORLEANS, LA.—The Great South Telephone & Telegraph Company will erect a building on Carondelet and Pondras Streets at an estimated cost of $500,000.

MUNCIE, IND.—The Kurtz National Telephone Company is making preparations to establish its plant and system in this place, a franchise having been granted.

OSWEGO, N. Y.—Wm. H. Drake, of Syracuse, has petitioned the Council for a franchise for a telephone plant. E. B. Powell, a local representative, also asked for a franchise.

DETROIT, MICH.—The Citizens' Telephone Company, of Wayne and Monroe Counties is about ready to open up for business. Its lines connect New Boston, Willow, Waltz, Flat Rock, Carlton and Rockwood.

VICTORIA, TEX.—The Gulf Coast Telephone Company, which recently built its lines into Victoria from Cuero, is now extending its system to adjacent towns. The Southwestern Telegraph & Telephone Company is also building its lines to Victoria.

SENECA FALLS, N. Y.—The Board of Trustees held a special meeting for the purpose of considering the advisability of granting a telephone franchise to a company who is desirous of operating in the village. Messrs. Crosby, Sanderson and Cushing are the committee who have charge of the matter.

DULUTH, MINN.—It is thought that the City Council will, at its meeting, grant a franchise to the Northwestern Long Distance Telephone Company to construct and operate its lines in this city. Heretofore the Council has opposed the granting of the franchise. The line is already built as far as Anoka and will be extended from that point to Paris.

Electric Light and Power.

BANGOR, WIS.—The Hussa Brewing Company is considering the matter of putting in an electric plant in connection with its brewery.

ST. LOUIS, MO.—It has been proposed to abolish arc lighting in the streets of St. Louis and substitute therefor incandescent lights. There is a great deal of opposition to the scheme.

SPRINGFIELD, TENN.—A firm has been organized in this place to erect an electric light and ice plant. By addressing Mr. Frank Bell particulars of the enterprise can be obtained.

WASHINGTON, D. C.—The investigation which has been undertaken by the State Bureaus of Statistics of Labor regarding the cost and efficiency of municipal heating and lighting, it is thought, will be commenced next Winter.

CARTHAGE, MO.—The directors of the Jasper County Light & Power Company which was recently incorporated here have elected the following officers: President, W. W. Calhoon; vice-president, Isaac Perkins; secretary, C. F. McElroy; treasurer, D. R. Goucher.

NEW HAVEN, CONN.—It is reported that the authorities of Yale College are considering plans for the construction of an electric light plant for the illumination of all of the college buildings. It is estimated that the buildings can be electrically lighted at a cost one third that now paid for gas illumination.

BEATRICE, NEB.—A new electrical company, bearing the name of the Beatrice Heat, Light & Power Company, filed a petition with the City Council asking a franchise to operate a plant in the city. The company is made up of New York capitalists who failed in an effort to purchase the plant already in operation.

PITTSFIELD, MASS.—Fire a few days ago caused considerable damage to the plant of the Stanley Electric Manufacturing Company. The fire started in an adjoining planing mill, which was located in close proximity to the Stanley Company's property. Just how much damage was done to the electrical company's plant is not stated.

BIRDSBORO, PA.—F. E. Bailey & Co., Philadelphia, Pa., have received the contract for the construction of a complete electric light plant for the Birdsboro Electric Light & Power Company. The plant will have a capacity of 1000 lights. The engine will be of 130 horse-power and will be supplied by the same firm. It is of the Armington & Sims make.

ST. GEORGE, S. I.—On Friday, Oct. 30, the property of the Electric Power Company at this place was resold by the referee. The purchaser was Paul D. Cravath, in behalf of the Richmond Borough Electric Company, which was recently organized in the interests of Erastus Wiman. It is stated that the business has accumulated nearly $80,000 in cash under the receiver, which, with the assets now realized on, will nearly liquidate the indebtedness of the company and relieve Mr. Wiman of liability as indorser.

The Electric Railway.

NEVADA, MO.—The horse-car service will be replaced with an electric line.

EXETER, N. H.—Steps are being taken looking to the organization of an electric railway company.

NEW BRITAIN, CONN.—The extension of the electric road from New Britain to Hartford is favored.

RUTHERFORD, N. J.—The Union Traction Company, of Rutherford, it is stated, will erect a new power-house and car barn.

ROCKVILLE, CONN.—The City Council of Rockville has granted the Rockville & Ellington Street Railway the right to build an electric railway in the city.

GEORGETOWN, D. C.—Plans are now under consideration by the officials of the Great Falls Electric Railway to build a double line of tracks from Georgetown as far as the District line.

BROOKLYN, N. Y.—The plan to build a railway from Kings Park to Central Islip, connecting the two hospitals for the insane, is to come up for the discussion of the Hospital Board at their meeting.

BALTIMORE, MD.—Mr. Henry introduced an ordinance to the Second Branch, granting permission to the Central Railway Company to construct underground conduits in which to place its feed wires.

SAGINAW, MICH.—The Interurban Railway will put in at once a metallic circuit long-distance telephone service between the valley cities to facilitate operations. Telephones will be placed in Saginaw and Bay City.

OWOSSO, MICH.—The Owosso & Corunna Traction Company and the Owosso Electric Company have been consolidated. The companies are now conducted by Mr. J. A. H. Ralph, president of the Traction Company.

DOYLESTOWN, PA.—It is stated that the extension of the Newtown & Bristol trolley line up the Newportville road to Fallsington and Morrisville will probably be constructed next Spring. The right of way has been secured.

POTTSVILLE, PA.—At a special meeting of the Town Council was adopted the ordinance submitted by President Koch, of the Schuylkill Electric Railway Company, in which that company was given the franchise of occupying the streets.

ASHLAND, PA.—The directors of the Mt. Carmel-Shamokin Electric Railway held a meeting at Philadelphia, and decided to build a railway between Ashland and Centralia as soon as possible. Surveyors will be put to work on the proposed route.

SEDALIA, MO.—Edward Wood, of Chicago, backed by New York and Boston capitalists, proposes to construct an electric car line from Monett to this city. Branches will run from Leesville to Butler, *via* Clinton, and from Leesville to Osceola and Stockton.

NEW HAVEN, CONN.—The preliminary survey is in progress for an extensive third rail electric road to connect Torrington, Litchfield, Harwinton and Unionville in this State, and with an extension to Bantam Lake. The petition to the next Legislature for the road has already been drafted.

WEBSTER, MASS.—An effort will be made this Winter to secure a franchise from the Legislature for an electric street railway in Worcester. Hezekiah Konant, N. T. Hurlbut, Cyrus Spaulding, L. E. Eddy, John Flint, M. P. Clare, E. L. Spaulding, J. W. Dobbie and E. N. Bigelow are the projectors.

NEW HAVEN, CONN.—The Southern New England Telephone Company has inaugurated a large reduction in its rates. Hereafter, when five subscribers are so situated that they can be placed on one circuit, local service will be furnished them to the amount of 300 communications for $25 a year.

Personal Notes.

MR. I. H. SHERWOOD, a graduate of the Case School of Applied Science, Cleveland, O., has been employed as assistant instructor in the Correspondence School of Technology, Cleveland, O. Mr. Sherwood is also assistant instructor in the course of electrical engineering at the Cleveland Y. M. C. A. He is a practical machinist and engineer, and is now a licensed stationary engineer.

WILLIAM CARPENTER CAMP.—A noteworthy acquisition to the electrical trade in Chicago is the recent entrance therein of Mr. William Carpenter Camp, who has become largely interested in the Metropolitan Electric Company of that city. Mr. Camp does not enter this new field with a technical knowledge of the business he has become connected with, but he brings with him a business experience that will no doubt be of substantial benefit to the Metropolitan Company. Mr. Camp was born in Chicago about 23 years ago, and received his education in one of the Eastern colleges. He afterward traveled in England and on the Continent. He is better known to the musical trade in the West than he is to the electrical trade. He was formerly treasurer of the Estey & Camp Piano & Organ Company, of Chicago, holding the position of manager, to which he succeeded on the death of his father a few months ago. Mr. Camp has been elected treasurer of the Metropolitan Company, and no doubt his extensive business experience will be well applied in his new connection. The Metropolitan Company and the electrical trade in Chicago may well be congratulated on the good fortune of having Mr. Camp initiated into the mystic circle, and we trust that this gentleman will find his new business relations entirely congenial.

W. C. Camp.

Trade and Industrial Notes.

THE AMERICAN ELECTRIC METER COMPANY, Philadelphia, has just issued a neat little pamphlet describing and illustrating its electric meters.

THE D. A. KUSEL TELEPHONE MANUFACTURING COMPANY, 1105 Pine Street, St. Louis, Mo., has just issued a catalogue and price list of its

telephone apparatus. Several testimonials are given concerning the efficiency of the instruments.

THE WALKER COMPANY, Cleveland, O., is issuing a circular to the street railway companies of the country, warning them against attempts to tie them up to high prices and no competition. It advises purchasers of railway and other electrical apparatus not to countenance such methods.

MR. D. A. KUSEL is president of the D. A. Kusel Telephone Manufacturing Company, of St. Louis, and Mr. I. J. Kusel is president of the Missouri Telephone Company, of the same city. In our issue of Oct. 31 we inadvertently mentioned Mr. D. A. as being connected with the Missouri Company, and he writes to ask us to say that such is not the case.

K. MACLENNAN & CO., Marquette Building, Chicago, manufacturers of the celebrated Gale's commutator compound, have inaugurated a new feature. They request all users of generators and motors who are troubled with sparking and cutting to send for free sample sticks and report their results from the trial, and the same will be published in the columns of this paper weekly.

THE KINSMAN 150-HOUR LAMP.—Among the new bidders for popular favor in the line of incandescent arc lamps is the Kinsman lamp which is thoroughly described and illustrated in a neat little pamphlet just issued by the Electric Construction & Supply Company, 110 Liberty Street, New York. The advantages and all the details of this lamp are completely set forth in the pamphlet.

THE INTERIOR CONDUIT & INSULATION COMPANY of New York City announces a reduction in the prices of its well-known brass-armored insulating conduit, elbows and couplings. The enormous sales of this material during the past year have had the effect of reducing the cost of production, hence the reduction in price. This company will shortly place upon the market a new and improved iron-armored conduit.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has recently furnished a special order of 5000 feet of Armorite iron-armored interior conduit specially painted while hot with a compound design to protect the iron pipe from rust and corrosion. While this protection is not generally necessary in using iron armored conduit, it seemed desirable in this particular case, and experts have pronounced this carload of conduit to be the finest lot of iron-armored conduit that has ever been seen in Chicago.

MESSRS. F. E. BAILEY & CO., Betz Building, Philadelphia, Pa., representatives of the Armington & Sims Engine Company, Providence, R. I., have recently received orders for engines as follows: One 150-hp engine for the electric light plant owned by the borough of Quakertown, Quakertown, Pa.; one 500-hp engine for the Nanticoke Electric Light, Heat & Power Company, Nanticoke, Pa.: two 40-hp engines and one 140-hp engine for the electric light plant of the Mansion House, Reading, Pa. Most of these engines are of the new self-oiling type with improved governor, which are in large demand at the present time.

MR. E. H. BENNETT, JR., general manager of the Diehl Electric Company, of Elizabethport, N. J., has had an admirable training for the position he holds. His father has long been general manager of the Singer Manufacturing Company, whose extensive works adjoin those of the Diehl Company. The specialties of the Diehl Company receive the same thorough and conscientious attention in every detail that has gained for the product of the Singer Manufacturing Company its world-wide reputation. "Diehl Electric" on a fan motor, or anything else, is a guarantee of excellence. The company, after exhaustive tests in actual practice, has just put its new long-life arc lamp on the market, and is willing to stake its reputation on the satisfaction the lamp will give. The orders already received for the lamp keep the factory busy and demonstrate the confidence felt in it by the trade.

THE AMERICAN ENGINE COMPANY, of Bound Brook, N. J., has begun the shipment of its new engines, known to the trade as American Ball engines. The first of these engines of 100-hp capacity has gone to the Detroit *Evening News*, and the second, a 50-hp engine, to the Savannah *News*. Since the addition of this new line of work, the business of the American Engine Company has increased so that it is now compelled to run double time, having installed a night force. In the electrical department, among the recent shipments are the following: Cliff Paper Company, Niagara Falls, N. Y., two motors, 150 horsepower each; Detroit *Evening News*, Detroit, Mich., two dynamos, each 25 kilowatts; Albany *Morning Express*, Albany, N. Y., one 18-kw dynamo; Oakland *Tribune*, Oakland, Cal., 25-hp motor; A. N. Kellogg Newspaper Company Chicago, Ill., four 25-hp and one 25-hp motors; Topeka *Capital*, Topeka, Kan. five-hp motor; Boston *Traveler*, 12-hp and five hp-motors; Worcester *Post*, Worcester, Mass., nine-kw dynamo; Cincinnati *Post*, Cincinnati, O., 35-hp motor; Philadelphia *News*, 25-hp and one three-hp motor; Elmira *Gazette*, 25-hp motor; American Newspaper Publishing Company, 25-hp motor; Carrington Publishing Company, 12-hp motor; J. B. Cranfill, Waco, Tex., 25-hp motor; Fall River Publishing Company, Fall River, Mass., one 25-hp and three-hp motor; Saginaw *Evening News*, Saginaw, Mich., 15-hp motor; B. A. Meade Company, Augusta, Me., three-hp motor; Chicago *Journal*, 15-hp motor; Grand Rapids *Democrat*, 15-hp and three-hp motor; St. Paul *Pioneer Press*, St. Paul, Minn., five-hp motor; Wallace Publishing Company, Des Moines, Ia., 12-hp motor; New York *Tribune*, two 15-hp motors; Rubber Tire Wheel Company, New York, N. Y., 12-hp motor.

Business Notices.

THE EMPIRE STATE EXPRESS of the New York Central is the fastest and most famous train in the world.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67–71 Park Place, New York.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 3, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

570,454. GALVANOMETER; C. Coleman, Chicago, Ill. App. filed June 9, 1896. The combination of a pivoted armature and magnet, having pole-pieces provided with overlapping portions, whose opposing surfaces are parallel and concentric with the axis of motion of the armature.

570,475. TROLLEY; J. A. Hance, St. Louis, Mo. App. filed Feb. 26, 1896. In a trolley-truck, two-grooved wheels mounted for rotation in a frame, two smaller grooved wheels mounted for rotation in said frame, and between the first two wheels, all of said wheels being in a running line and the top of the two intermediate wheels being slightly below the line of the top of the two outer wheels, and a rocking and swivel connection between said frame and the trolley pole.

570,481. INSTRUMENT FOR MEASURING ELECTRIC CURRENTS; R. M. Hunter, Philadelphia, Pa. App. filed Oct. 4, 1892. In a measuring instrument for measuring electric currents, the combination of an expansion wire over which the current is caused to flow, a movable pointer or indicator movable thereby, a dial plate over which the pointer is moved, a firm support for the dial plate having a coefficient of expansion relative to that of the expansion-wire, whereby normal changes of temperature surrounding the meter will cause the zero point to be shifted automatically in the same direction as the shifting of the pointer due to the same changes, a cup containing a liquid and a paddle carried by the pointer or indicator and working in the liquid in the cup for the purpose of making the meter dead-beat in its action.

570,496. MAGNETIC SEPARATOR FOR THRESHING MACHINES; E. H. Osborn, Des Moines, Ia. App. filed Jan. 24, 1896. In a threshing machine, a series of metallic bars located in the path of travel of the tailings from the machine to the cylinder and forming a bottom over which the tailings must pass to the cylinder, and an electric bell circuit connected with said metallic bars, which bell circuit is normally open and is closed by the contact with said bars of a foreign metallic body.

570,508. ELECTRIC ALARM BELL; R. Segerdahl, Chicago, Ill. App. filed June 27, 1892. In an electric cell (or signaling device) a striker-lever consisting of a lever of the first class, having a weight, a shaft and projections formed integral, and an armature which is formed separate and secured to the said lever.

570,517. INCANDESCENT LAMP AND SOCKET; A. Swan, New York, N. Y. App. filed Jan. 23, 1896. A base for incandescent lamps, consisting of a cup made of insulating material provided on its lower outer edge with a metallic ring and having a cylindrical cavity containing a metallic shell, the conductors of the lamp being respectively connected with the ring and the shell.

570,565. ELECTRIC RAILWAY; H. C. Reagan, Jr., Philadelphia, Pa. App. filed March 11, 1896. In an electric railway, a feed-wire, a conduit, a conductor supported therein, a contact movably mounted on said feed-wire, said contact having a suitable body portion, a sleeve surrounding the feed wire and engaged by said body portion, said sleeve having a resilient arm extending therefrom, and adapted to complete the circuit between said feed-wire and conductor at proper intervals.

570,566. MAGNETIC PATH FOR UNDERGROUND RAILWAYS; H. C. Reagan, Jr., Philadelphia, Pa. App. filed April 21, 1896. In an underground railway, a conduit containing a plurality of contacting devices, suitable protecting or paving material adapted to cover the top of said conduit, a series of independent magnetic paths, separated from each other and embedded in said material, and extending from the surface thereof, toward but not into the interior of said conduit, and over said contacting devices, and said magnetic paths being out of electrical connection with the interior of the conduit.

570,599. RETURN CIRCUIT FOR ELECTRIC RAILWAYS; G. Kapp, Berlin, Germany. App. filed Dec. 31, 1895. In electric railways using the track as return-conductor, the combination with insulated return feeders connected to the track at points remote from the power-station, and of auxiliary sources of E. M. F. inserted into the said return feeders.

570,616. BURGLAR ALARM; F. Steinkoenig, Sioux City, Ia. App. filed June 12, 1896. The combination with a series of apartments, of an indicating apparatus in each apartment, a mechanism in each apartment actuated by the entrance of a burglar, and connections between the mechanism and the indicating apparatuses in the other rooms, whereby such indicating apparatuses are operated, but the indicating apparatus in the room entered is not operated by the mechanism.

570,619. PROCESS OF MANUFACTURING PLATES FOR SECONDARY BATTERIES; C. H. Weise, Possneck, Germany. App. filed April 4, 1895. The method of forming accumulator-plates which consists in confining a pasty mass of lead compound in an acid-proof frame or vessel having perforated sides, passing cellulose threads through the perforations of the frame, placing the same in an acid bath, passing an electric current through the same, and finally exposing the formed hardened plate to the action of the air to destroy the chemically changed cellulose.

570,663. METHOD OF AND APPARATUS FOR REGULATING DYNAMO ELECTRIC GENERATORS OR MOTORS; J. W. Easton, Brooklyn, N. Y. App. filed April 1, 1892. The combination with a dynamo or motor having a plurality of pole-pieces arranged in sets of divisions, of a circuit controll-

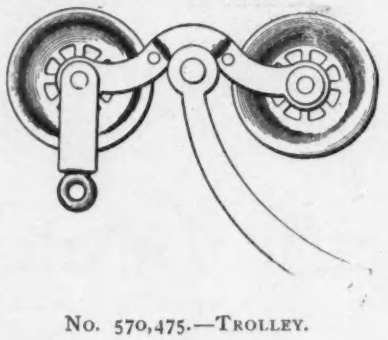
ing device actuated by variations in the output or load of the machine for varying or changing the power or polarity of one set of pole-pieces independently of the others.

570,700. TRACK INSTRUMENT; T. B. Dixon, Henderson, Ky. App. filed Sept. 12, 1895. In a track instrument, the combination with a magnet producing a magnetic field adapted to influence a magnetically-operated signal-controlling device, said magnet having pole-pieces so arranged that when a train passes over the track a portion of the magnetic circuit is diverted from said field by being shunted through the magnetic portions of the train, and the magnetic field is thereby weakened, and an armature movably mounted in said magnetic field and arranged to be influenced thereby, a retractile device opposing the action of said magnetic field on said armature, whereby when said magnetic field is weakened said armature is retracted, and a signal controlling device operated by the movement of the armature.

570,740. TROLLEY; F. T. Walton, Portland, Me. App. filed May 23, 1896. In a trolley in combination, a suitable shank divided in two sections, the upper part thereof being provided with a tongue, the lower part provided with a groove, a socket in the bottom of said groove, a spring-actuated T-post seated in said socket, and means for pivotally fastening said tongue in said groove.

570,773. TELEPHONE SWITCH; C. N. Sandbeck, Harmony, Minn. App. filed April 8, 1896. A telephone switch comprising a casing, two spring contacts arranged therein, contact fingers adapted for engagement with one of the spring contacts, plates movable to engage the other of said spring-contacts, and to move the contact-fingers to close a circuit, and electrical connections.

570,808. SAFETY SWITCH; E. Jokl and W. M. Christian, Vienna, Austria-Hungary. App. filed Aug. 14, 1896. The combination with a casing or receptacle filled with mercury, one or more plugs secured to such casing and dipping into the mercury therein, conducting pins or bolts insulated from the mercury and entering into such plugs, the diameter of their inner ends being smaller than the diameter of the bore of the plugs designed to receive such insulating films or membranes, tightly closing the ends of the bores of the plugs, such films or membranes being in contact with the inner ends of the pins or bolts, and insulating them from the mercury in the casing or receptacle, and a terminal permanently connected with the mercury.



No. 570,475.—Trolley.

570,823. ELECTRIC ARC LAMP; H. A. Seymour, Washington, D. C. App. filed July 1, 1896. In an arc lamp, the combination with its upper and feeding carbon, and regulating mechanism comprising a coarse-wire magnet included in series with the arc, for raising and lowering and feeding the upper carbon of the lower and non-feeding carbon, and a magnet and dash pot associated therewith, and constructed and adapted to slowly and gradually separate the lower carbon from the upper carbon when the lamp is switched into circuit and thereby draw the arc to any desired length, and to maintain the lower carbon at the limit of its downward movement throughout the normal operation of the lamp in burning its carbons.

570,824. ELECTRIC ARC LAMP; H. A. Seymour, Washington, D. C. App. filed July 7, 1896. In an arc lamp, the combination with its carbons and regulating mechanism for feeding the carbons simultaneously and thereby maintain the arc at a fixed point, of means acting independently of the regulating mechanism and associated with the lower carbon for slowly and gradually separating it from the upper carbon when the lamp is switched into circuit and thereby drawing the arc to any desired length.

570,825. CARBON FOR ARC LAMPS; D. A. Shesler, Toledo, O. App. filed Feb. 13, 1896. A composition for carbons for electric arc lights, consisting of graphitoid silicon, asbestos, carbon, and a binder.

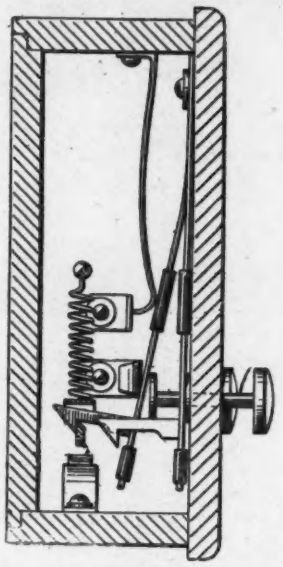
570,827. ELECTRICALLY CONTROLLED ELEVATOR; S. D. Strohm, Philadelphia, Pa. App. filed April 4, 1896. In an elevator the combination of a car or cage, means for operating the same, mechanism for controlling said operating means, a solenoid or magnet for operating said controlling means, a safety-circuit extending through the landings for operating said solenoid or magnet, a push-button at each landing for closing or breaking the safety-circuit, a shunt around each push-button and a closer or breaker in said shunt operated by the elevator car.

570,839. TOWING APPARATUS; A. de Bovet, Paris, France. App. filed April 5, 1894. In a towing apparatus, the combination of an elastically supported electric motor, a magnetized friction pulley connected with and adapted to be actuated from said motor, a fly-wheel with which said pulley is in elastic contact, a towing-wheel and gearing intermediate said towing-wheel and fly-wheel shaft.

570,840. AUTOMATIC TELEPHONE SYSTEM; M. Brooks, Minneapolis, Minn. App. filed Jan. 26, 1895. The combination with a return connection and three or more lines or circuits normally distinct, of translating devices each represented by two of said lines, a source or sources of energy, and means for energizing any combination of two lines, and means connected with the energized lines whereby the circuit of the translating device represented by said two lines will be closed through one of said lines to said return connection.

570,845. SUBSTANCE FOR TELEPHONE-ELECTRODES; D. Drawbaugh, Eberly's Mill, Pa. App. filed Jan. 10, 1896. A microphonic element composed of a substance having its surface covered with platinum black.

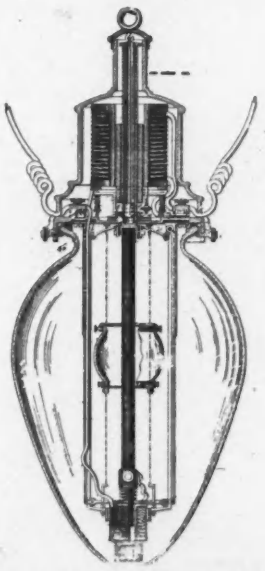
570,852. TYPE PRINTING TELEGRAPHIC APPARATUS; F. H. W. Higgins, London, England. App. filed Oct. 11, 1895. A type printing telegraph



No. 570,773.—Telephone Switch.

instrument having two type-wheels, a shifting shield adapted to cover or be brought in front of either type-wheel and leave the other type-wheel exposed, two impression pads, one for each type-wheel, the impression-lever on which the pads are mounted, a single line circuit, electromagnetic devices in the line circuit for actuating the impression lever, and electromagnetic devices also in the line circuit, independent of those actuating the impression-lever, for shifting the shield to interpose it between either type-wheel and its impression-pad, and leave the other type-wheel exposed to its pad so that an impression may be taken therefrom.

570,878. MULTIPLE-SERIES CONTROLLER; J. F. McElroy, Albany, N. Y. App. filed Aug. 28, 1894. In a multiple-series controller, and cylinder suitably mounted, metallic contact points in the surface of said cylinder, fingers suitably mounted to rest on said cylinder, a means for conveying the current from the positive pole to one of said fingers, contact-posts adapted to connect the positive with the negative pole of the controller, a means for locking the connecting posts in contact with the poles of the controller by means of a locking device operating upon the frame carrying the post, tending to prevent the elevation of the frame and simultaneously locking the cylinder to the post-carrying frame by means of suitable engagement therewith.



No. 570,824.—Electric Arc Lamp.

570,882. AUTOMATIC-SAFETY DEVICE FOR ELECTRIC CIRCUITS; L. G. Rowand, Camden, N. J. App. filed Sept. 13, 1895. Two circuits in multiple having a common connection with the source of current supply, and a normally-closed switch controlling said common connection, an electromagnet having reverse windings creating a normally ineffective field, one winding being in one circuit and the other winding in the other circuit, said magnet controlling the operation of the switch, and adapted when its field becomes effective to open said switch.